Cape Peninsula
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# Effects of Rapid Technology Advancement (RTA) on IT-audit skills and competencies within the financial services sector in South Africa

**by**

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**DECLARATION**

I, Siviwe Prudence Tyaliti, declare that the contents of this dissertation/thesis represent my unaided work and that the dissertation/thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed _____ Date _____

**ABSTRACT**

The Internal auditing profession operates in an era where disruptive technological advances shape business models, productivity, and risk landscapes. Rapid technological advancements such as advanced analytics, robotic process automation (RPA), machine learning, and cognitive intelligence have introduced complexities to business operations and risk management. The ability of internal audit professionals to adapt and contribute effectively in this evolving landscape is contingent upon their technical skills and competencies, requiring continuous improvement in line with International Professional Practices Framework (IPPF) Standard 1230. Falling behind in these competencies could render professionals obsolete and ineffective.

While existing literature has explored the impact of these technologies on businesses and the competencies required for internal audit professionals, a notable gap exists regarding the alignment of current IT audit training strategies and skills development plans with the demands brought by the rapid adoption of technologies by businesses.

In response to this research gap, the present study employed a descriptive quantitative approach to examine whether disparities exist between IT audit professionals' skills and competencies and the requisites for navigating a swiftly evolving technological landscape. The study's focal point encompassed IT auditors, IT audit practitioners, and Internal Auditors responsible for ensuring IT information systems, managing IT risks, overseeing IT controls and governance, and delivering consulting services within the South African financial services sector. Participant selection employed the non-probability convenience sampling method. Data was gathered through a non-experimental cross-sectional research strategy, utilising an online Microsoft Forms survey as the primary data collection instrument. The analysis of 108 responses collected was conducted using SPSS, with certain elements involving Microsoft Visual Code Studio and Python Pandas. The study's outcomes elucidate substantial disparities, particularly in emerging technologies, where IT audit professionals demonstrated proficiency deficiencies. Additionally, the study underscores the heightened demand for technical skills and knowledge spanning a broad spectrum of subject areas.

This research contributes to the understanding of IT audit training strategies and skills development, emphasising the need for organisations to enhance their efforts to bridge competency gaps. The study's findings serve as a call to action for internal audit professionals, organisations, and educational institutions to align their training initiatives with the evolving technological landscape to remain relevant and effective in assuring the state of internal control environments and serving as trusted advisors within their organisations. The proposed model framework for developing a comprehensive curriculum for IT audit skills and competencies, as outlined in this research, provides valuable insights for various stakeholders. It underscores the need for organisations to take proactive measures in bridging competency gaps among IT audit professionals, particularly in the context of rapidly evolving technologies. The framework serves as a foundation for crafting relevant and effective training initiatives catering to the changing technological landscape. Ultimately, this research underscores the imperative of continuous learning and adaptation to thrive in the era of rapid technological advancement.

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## DEDICATION

I dedicate this thesis with profound love and gratitude to my mother Nolundi Constance Tyaliti, whose unwavering belief in me, and her constant support has allowed me to forge my own path in life. Her trust in the decisions I make has been an endless source of strength and motivation. Additionally, I dedicate this thesis to all the remarkable girls and women from my hometown, Tsolo Mpoza in the Eastern Cape, as a testament to the power of perseverance. May it serve as a reminder that when you refuse to give up, the universe has no choice but to grant you the dreams and aspirations you wholeheartedly pursue.

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ACCA | Association of Chartered Certified Accountants |
| AI | Artificial Intelligence |
| CI | Cognitive Intelligence |
| CI | Confidence Interval |
| DFSA | Dubai Financial Services Authority |
| FAIS | Financial Advisory and Intermediary Services |
| FCA | Financial Conduct Authority |
| FIC | Financial Intelligence Centre |
| FinTech | Financial Technologies |
| FSCA | Financial Sector Conduct Authority |
| FSP | Financial Services Provider |
| IAF | Internal Audit Function |
| ID | Unique response Identifiers |
| IFAC | International Federation of Accountants |
| IFWG | Intergovernmental Fintech Working Group |
| IIA | Institute of Internal Auditors |
| IPPF | International Professional Practices Framework |
| ISACA | Information Systems Audit and Control Association |

| | |
|---|---|
| ITAF | IT Audit Framework |
| NCR | National Credit Regulator |
| NLP | Natural Language Processing |
| OCC | Officer of the Comptroller of the Currency |
| PASA | Payment Association of South Africa |
| PCH | Payments Clearing House |
| PEU | Perceived Ease of Use (fundamental construct of TAM) |
| PSMB | Pembangunan sumber manusia berhad |
| PSO | Payments System Operator |
| PU | Perceived Usefulness (fundamental construct of TAM) |
| RPA | Robotics Process Automation |
| RPP | Rapid Payments Program |
| SAMOS | South African Multiple Options Settlement |
| SARB | South African Reserve Bank |
| TAM | Technology Adoption Model |

# CHAPTER 1

## INTRODUCTION AND PROBLEM IDENTIFICATION

### 1.1 Introduction

This chapter serves as the foundation for the entire research study and provides an overview of the structure and organisation of the thesis. It begins by defining the purpose and background of the study, highlighting its relevance in addressing a particular problem or a gap in existing literature. The underpinning theory discussing the philosophical points of departure that form the foundation for the research is then introduced, illustrating how it will guide the researcher's perspective and approach to conducting their investigation and contribute to knowledge in the field of research. The background section then delves into the existing literature, highlighting previous studies, theories, and gaps in knowledge that led to this current investigation.

Furthermore, this chapter outlines the specific problem to be addressed in the study and presents a rationale for why it deserves attention. By identifying a specific issue or gap in understanding that this thesis aims to address and stating the significance of the research, both academically and practically, readers can understand its potential impact. The aims, objectives and research questions are also outlined to provide a roadmap for what is explored throughout the research process. These questions serve as guiding principles for data collection, analysis, and interpretation.

Moreover, this chapter introduces the review of relevant literature related to the topic at hand. This literature review establishes a scholarly context for understanding previous research findings and identifies areas that have been adequately explored. By examining existing studies and theories, gaps and limitations become apparent, further justifying the need for this research study. However, a comprehensive review of the empirical literature is outlined in greater detail in Chapter 2.

Lastly, an outline of how subsequent chapters is organised within the thesis structure provides the readers with a roadmap of what they can expect from each chapter. This ensures clarity and coherence in presenting findings and arguments while systematically guiding readers through each inquiry stage. By laying out these

components in Chapter 1, readers gain a comprehensive understanding of what lies ahead while establishing a strong foundation for further exploration.

## 1.2 Background

The internal auditing profession recognises the risks of disruptive technological advances and trends in advanced analytics, robotic process automation (RPA), machine learning and cognitive intelligence (CI). These pervasive technological advances are rapidly reshaping business models, improving productivity, and enabling innovation in the way that organisations connect products and services to their consumers (Deloitte, 2018). These technological advances that are happening at a very rapid speed have resulted in complex, and integrative business models (Govender & Pretorius, 2015; Patterson, 2020). That has introduced new risks and made existing risks more complex, effectively evolving the entire risk landscape (Schutte & Marx, 2018). South Africa has been shown to have advanced innovation achievements and technology adoption by business compared to other African countries (Mayor et al., 2012). Internal Audit professionals need to understand and adapt to the changes in business models caused by these technological advancements (Khan, 2018) (ACCA & CA ANZ, 2019) (Brillinger et al., 2020). They must also be technologically sound with excellent project management skills (ACCA & CA ANZ, 2019) to be effective in their roles. All this will require Internal Audit professionals to continuously improve their technical skills and competencies, a requirement of the International Professional Practices Framework (IPPF) Standard 1230 (The IPPF, 2012). However, because technology moves rapidly, it also requires Internal Audit professionals to try to move at the same speed in acquiring these technical skills and competencies or risk becoming obsolete and ineffective (Forbes Insights, 2018).

Based on the available literature and industry expects publications, much research has been conducted on the impact of rapid technological advances that are disruptive or innovative adopted by businesses, Internal Audit departments, as well as the competencies and technical skills required by Internal Audit professionals to better navigate the evolving risk landscapes caused by these technologies. The literature includes why these technologies are adopted, how they change how businesses do business (Pellissier, 2000), how they affect the Internal Audit Function (Marx & Ravjee,

2015), and the competencies required by Internal Audit professionals to navigate these changes better (KPMG, 2014; Bailey, 2010; Plant et al., 2013). However, there seems to be little research that looks at whether the current IT audit training strategies and skills development plans align with the current competencies and skills demand brought by the rapid adoption of technologies by businesses.

Based on the Information Systems Audit and Control Association (ISACA) Future of IT Audit Research Brief, based on a survey of 2447 respondents who indicated to be in the Audit field, 64% felt that there is currently a stronger demand for technical skills while 46% believed that there is an increased expectation of skills and knowledge across broader subject areas (ISACA, 2019). The ISACA State of Cyber Security Report indicates that 57% of cybersecurity positions in their teams remain unfilled (ISACA, 2020). This is despite research that shows cyber-attacks and cyber-crime being a highly ranked risk in the world because of evolving sophisticated attacks that are made possible as new Technologies are being developed and adopted in businesses (World Economic Forum, 2020) (ISACA & Protiviti, 2020). In light of the foregoing, this study seeks to ascertain whether Internal Audit professionals are acquiring the technical skills and competencies required to stay relevant and effective in performing their mandate of assuring the state of internal control environments while also being trusted advisors of their organisation.

### 1.3 Underpinning theory

The study is underpinned by the Technology Adoption Model (TAM), a model that gained considerable support through the years in understanding and managing the process of new technology adoption (Chen et al., 2007). TAM is anchored on the fundamental constructs of perceived usefulness (PU) and perceived ease of use (PEU) (Dubihlela & Gwaka, 2020). The perceived usefulness component in the Technology Acceptance Model is the degree to which technology users believe that using a particular IT system will enhance their performance (Khan, 2018). The core idea of TAM is that a user's acceptance of technology is determined by his/her behavioural intention, which in turn is determined by his/her PU and PEU. Behavioural intention (BI) expresses the extent to which a user formulates conscious plans to use or not to use IT audit-related activities (Khan, 2018).

Audit skills and competencies are normally acquired through skills training but strongly related to the individual auditor's actual behaviour; in other words: if an auditor intends to embrace rapid advances in disruptive technology, then it is likely to be done. Therefore, TAM is employed in this study, underpinning the fact that auditors in the financial services sector formulate a positive attitude toward technology when they perceive it to be useful and easy to use (Schutte & Marx, 2018). Based on TAM, higher levels of PU and PEU predict favourable attitudes, which, in turn, predict intentions to use (Dubihlela, Chakabva & Tengeh, 2021). This study investigated the effect of Rapid Technological Advances (RTA) on the overall IT audit skills and competencies. This linkage is done through investigating and analysing Internal audit skills-development plans and training strategies within a given financial services setting. The research seeks to provide a better understanding of IT auditing skills and competencies for RTA as well as the acquiring of skills and competencies that are in demand in this technological new age.

### 1.4 Problem Statement

Technological advancements have caused an evolving risk landscape, necessitating an evolving internal control environment. Risk management strategies, processes and frameworks must align with these technological advancements (Schutte and Marx, 2018). This has resulted in Internal IT Auditors needing technical skills and new competencies to perform their mandate and continue being effective and relevant to organisations. Drawing upon the Johari Window Model, famously articulated by former US Secretary of State Donald Rumsfeld, Internal IT Auditors are confronted with a paradigm of 'Known Unknowns' – aspects they acknowledge not knowing. This includes an awareness of the technical knowledge and competencies they currently lack but must acquire to enhance their effectiveness (Lyons, 2020). Thus, it becomes imperative for organizations to equip their internal IT audit teams with the requisite skills to navigate this evolving landscape and address emerging challenges.

Auditor IT knowledge and competencies and Internal Control knowledge have been proven to correlate with the quality of Audit work (Siew et al., 2017). All Internal Audit professionals around the globe require these skills and competencies depending on the level of Technology adoption maturity of the different organisations they service. (Marx & Ravjee, 2015) also agree that the rapid technological advancements by

organisations influence the quality of audit work. Auditors are expected to keep abreast of technological advancements while maintaining independence from day-to-day operational involvement (Spiros, 2019). Addressing these demands requires IT auditors to ideally possess operational backgrounds and continuously update their knowledge and skills through ongoing education initiatives (Spiros, 2019). It is important to understand whether IT auditors in South Africa are continuously upskilling themselves with these skills to ensure the effectiveness and relevance of the IT audit function. The International Internal Audit Association's (IIA) March 2015 Pulse of Internal Audit survey corroborates the challenges faced by organizations in attracting and retaining skilled audit professionals. 40% of respondents identified talent acquisition and retention as high or critical priorities in their audit plans, with 54% citing competition for a limited pool of skilled auditors as a key factor contributing to skill gaps within audit teams (IIA, 2015).

In light of the literature presented, it is evident that the rapid advancement of technology has adverse impact on the skills and competencies of IT audit professionals. As organizations navigate this evolving landscape, initiatives aimed at enhancing the capabilities of auditors and adapting to changing demands are imperative to ensure effective audit practices and mitigate potential risks associated with technological advancements. IT audit professionals lacking skills and competencies in Information Technology make it difficult for the profession to adapt to technological advances (Abou-El-Sood et al., 2015). This affects the quality of audit delivery as organisations' systems and processes are continually changing due to these technological advances (Petterson, 2005). New regulation such as the POPI Act has also made it crucial for IT audit professionals to keep abreast of technological advancements in their organisations; these advances in systems and processes have an impact on complying with the Act by organisations (Govender, 2019).

## Rationale and Significance of the Study

The main role of an Internal Audit department is to add value to an organisation by providing objective and relevant assurance and consulting services contributing to the effectiveness and efficiency of governance, risk management and control processes. This is done when Internal Auditors apply the care and skill expected of a reasonably prudent and competent Internal Auditor with the knowledge, skills and other

competencies needed to perform their responsibilities (IIA, 2012). The Information Systems Audit and Control Association (ISACA), in its IT Audit Framework (ITAF) standard 1006- Proficiency, require IT Auditors to conduct audit and assurance engagements that they possess professional competence and adequate knowledge of the subject matter as well as maintaining professional competence through appropriate continuing professional education and training (ITAF, 2020).

The 2020 report on Internal Audit Capabilities and Needs Survey conducted by Protiviti indicates that most audit functions need to improve their acquisition and development of next-generation auditing skills quickly (ISACA & Protiviti, 2020). Which would suggest or imply that there might be a misalignment in the current skills and competencies in relation to the required skills and competencies of IT Auditors. Henceforth, the study seeks to investigate this assumption. Therefore, IT auditors are required to possess the knowledge, skills and other competencies needed to evaluate IT risks, provide independent assurance over IT controls, provide independent assurance over the IT governance processes and consider the impact of information technology on the organisation and its resultant impact on internal Auditing (Marx & Ravjee, 2015). There is a misalignment between current IT audit competencies and skills and the required competencies and skills for emerging audit environments. This means there is a need for Internal Audit departments, IT audit individuals, professional bodies, and learning institutions to tailor their training programs and skills development plans to focus on skills and competence gaps identifiable in the sector. The study assisted Internal Audit departments in developing skills and competence-based talent acquisition strategies.

## 1.5 Aim and Objectives of the Study.

### 1.5.1 Aims

The main aim of this study is to investigate whether IT audit professionals' skills and competencies align with the current skills and competencies required in this technologically advancing landscape by analysing the levels of technical knowledge and competencies that IT Audit professionals currently possess in relation to the desired skills and competencies required.

### 1.5.2 Objectives

- To ascertain the advanced technologies prevalent within the financial services sector and explore their impact on IT audit skills and competencies.
- To assess the skills and competencies of IT audit professionals in the financial services sector.
- To establish the nature of skills that are prerequisites for the financial services sector in South Africa to deliver quality IT audits.
- To establish the nature of competencies that are prerequisites for the financial services sector in South Africa to deliver quality IT audits.
- To identify any disparities between IT audit professionals' current skills and competencies and the skills and competencies required for adapting to the Rapid Technology Advanced landscape.
- To establish the training needs necessary within the financial services sector that will enable IT audit professionals to have these skills and competencies.

## 1.6 Research Questions

This study is driven by the main question: "Is there an alignment between the skills and competencies that IT auditors possess and the skills and competencies required by technologically advanced organisations?" In answering the above, the study attempted to answer the following sub-questions:

- What are the advanced technologies in the financial services sector, and how do they affect IT audit skills and competencies?
- What are IT audit professionals' current skills and competencies in the financial services sector?
- What are the nature of skills that are prerequisites for the financial services sector in South Africa to deliver quality IT audits?
- What are IT audit professionals' key financial services sector competencies?
- Are there any deviations noted between current IT auditor Skills and competencies and the desired skills and competencies?
- What training does the financial services sector require to give IT audit professionals the prerequisite skills and competencies to deliver quality IT audits?

## 1.7 Key Aspects of the Literature Review

In order for Internal Auditors to demonstrate their compliance with the ITAF standard 1006, they need to demonstrate that they possess the right skills, professional knowledge and competencies as these have direct relations with productivity, employability, and sustainable development (Moojen, 2015). These skills and competencies are greatly affected by the advancement of technology as daily business operations and organisations' business models are transforming (Khan, 2018). Internal audit as a profession is also not immune to these technology disruptions, as highlighted by the findings of the KPMG and Forbes Insights Survey, which notes that auditors are now expected to use bigger samples and sophisticated technologies to expand their roles. These advances in technologies such as data, advanced analytics, robotics process automation, and cognitive and emerging innovations require IT Auditors who know how to use them to meet client expectations (Forbes Insights, 2017).

Generally, organisations currently expect the Internal Audit department to no longer provide a rear-view mirror view but instead, to provide a forward-looking view to add value to organisations and help them navigate the new risk landscape, opportunities, competition and globalisation (Forbes Insights, 2017). In light of all this, the major question is whether IT audit professionals are keeping up with the pace of change brought by technological advancements. Hisham Farouk, CEO and global board Member at Grant Thornton, during a breakfast discussion at the Dubai Financial Services Authority (DFSA). In December 2017, they also had the same question, suggesting that this issue is being considered at top levels of management (Khan, 2018).

IT audit quality is an essential part of any Audit department as organisations have become dependent on IT for successful operations, management and achievement of business objectives (Siew et al., 2017). The new world of work that has been enabled by the 4th industrial revolution where new technological advances are not only changing the business models of organisations but also the risk landscape has challenged Internal Audit professionals to re-look their skill sets and competencies in order to stay relevant and effective. Internal Audit professionals are now expected to possess technological skills and understand digital platforms and processes (CIA,

2020). Francis Green explained a skill as a personal quality with three key components: Productive – should produce positive results; Expandable – personal qualities that change through training and development; and Social-regarded as status (Green, 2011; Abdel-Wahab et al., 2005).

(Losue, 2020), in the special report on new skills for auditors, noted that the new technical skills that is critical for auditing include:

- Data analytics design (leveraging RPA and AI)
- Data analytics interpretation and reporting
- Understanding IT
- Knowledge of IT's impact on security, understanding data ingestion channels
- Willingness to embrace emerging technologies.

Even though the notion of skill differs per discipline (Green, 2011; Abdel-Wahab et al., 2005; Attewell, 1990), at its core, it suggests the ability to perform a particular task well. (Attewell, 1990). In Much literature, skill is often defined in conjunction with competency, described as "the ability to do something successfully or efficiently" by the Oxford Dictionary (Oxford English Dictionary, 2007). However, this research focuses on competencies, which are defined differently from mere competency. (Heinsman et al., 2007) assert that competencies encompass knowledge, skills, abilities, and personality traits. This definition is consistent with that provided by Ohio University in their professional Development Pathways framework.

The report by Mike Losue notes that Auditors of the future need strong foundations in data analysis, an understanding of how RPA and automation work and an understanding of IT systems (Losue, 2020). Forbes in their report of Audit 2025 believes that Auditors need to keep pace with the evolving technology and changing regulatory environment while also horning their technology, critical thinking and communication skills in order to meet audit demands of the future (Forbes Insights, 2017). In his article "Building the Auditing Skills of the Future", Ian Scott also reports that data analytics, critical thinking and communication skills are among the critical skills required by Auditors (Scott, 2019). A report by Caseware re-iterates the points made by Mike Iosue that data analytics, both the ability to extract the data from

systems using artificial intelligence and machine learning, understanding how to utilise the data to be useful in the audit, and being able to review and understand the data, is the most critical technology skills for audit professionals to have (Bistra et al., 2018).

It is apparent from the literature available that the top technologies that are receiving more focus and are most disruptive to IT audit professionals are blockchain, machine learning, artificial intelligence, robotic process automation and data analytics (Scott, 2019; Khan, 2018; CIA, 2020). To briefly describe these skills and technologies based on the definitions sourced from research journals and industry reports, Artificial Intelligence (AI) is an evolving technology that requires computer programs designed to function the way human intelligence would. This includes learning, perception, problem-solving, language understanding and logical reasoning. (ACCA & CA ANZ, 2019; Mohameed, 2019).

Robotic process automation is software that can be easily programmed or instructed by end users to perform high volume, repeatable, rules-based tasks in today's world where multiple loosely integrated systems are commonplace (ACCA & CA ANZ, 2019). Machine learning uses input data as well as statistical analysis to make predictions and decisions while updating outputs with new data (Mohameed, 2019). Data analytics is the science of analysing raw data to obtain usable and useful information (IFAC, 2018). Blockchain is an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way (Lansiti & Lakhani, 2017). Communication skills is the ability to organise and communicate thoughts, ideas and conclusions reached through audit engagements unambiguously and concisely using language that is free of technical jargon (Uwaleke & Ubaka, 2016). Critical thinking skills is the art of examining a situation or task from numerous perspectives for the development of supportable conclusions derived from questioning the validity of both the premises and the conclusions of assessed results in a logical manner (KPMG, 2014; Schleifer & Greenawalt, 1996).

According to a survey conducted by ACCA in 2019 on its members and affiliates, on average, 62% of respondents had not heard/ heard but did not know what it was/ had only a basic understanding of terms such as artificial intelligence, machine learning, natural language processing, data analytics and robotic process automation (ACCA & CA ANZ, 2019). This indicates that although the critical technology skills are known,

Internal Auditors have still to acquire them. "The question is no longer whether the auditor needs to change; it's how fast?" (Forbes Insights, 2018). Looking at all the literature, it is apparent that extensive research has been conducted to determine the skills IT auditors need to become effective in technologically advanced organisations. However, no evidence exists from empirical studies and industry investigations suggesting that IT auditors possess these skills and competencies. Henceforth, this study will investigate any misalignments between these two variables.

## 1.8 Definition of Key Concepts

*IT audit* - Is a formal, independent, and objective examination of an organisation's infrastructure, governance, risks, procedures, and controls that involves information technology, whether as the specific subject under review or as the means to conduct the review (Siew et al., 2017; Otero et al., 2019).

*IT auditor* - Is an audit professional whose responsibility is to provide reasonable assurance that the information generated by applications within the organisation is accurate and complete, governance of IT aligns with organisation objectives and risks related to IT are mitigated through sufficient controls implementation (Otero et al., 2019; ITAF, 2020). Technological advancement- "is the generation of information or the discovery of knowledge that advances the understanding of practical application of scientific knowledge and principles. (Enduro, 2014).

*Skills and competencies* - a combination of skills, knowledge, attributes and behaviours that enable an individual to perform a task or an activity successfully is defined as a competency. In contrast, a skill relates to a specific learned ability that one requires to perform an activity or tasking successfully (Admin, 2012; IAEA, 2020; Wallace, 1975).

*IT Audit quality* - The efficiency and effective examination or evaluation of IT infrastructure, IT governance, IT risks, IT procedures, and IT controls in line with the set standards and regulations of the Audit department (Nguyen et al., 2020).

## 1.9 Research Paradigm, Approach, Design, and Data Collection Methods

### 1.9.1 Research paradigm

The study intended to prove, by applying the methodological assumptions of positivism in employing a descriptive quantitative approach, the hypothesis that rapid technological advancements have created a misalignment of skills and competencies of IT auditors in South Africa. Positivism "advocates the method of hypothesis testing as a general procedure for generating and validating scientific knowledge" (Coolen, 2012). The positivist philosophy was chosen because it allows logic and empirical inquiry to validate truth claims (Coolen, 2012). The study neglected to follow other paradigms, such as constructivism and critical philosophy, for these reasons;

Constructivism paradigm generally theorises about knowledge (Zietsman, 1996) where learning is viewed as an active process (Pereira and Sithole, 2019). Meaning that the paradigm deals with how IT auditors are learning the skills needed and does not necessarily assist in answering the research question of whether they do possess these skills.

The Critical philosophy focuses only on knowledge of phenomena that experience alone renders the foundation for cognition (Wallace, 1975). As logic instead of facts is the foundation upon which this philosophy is grounded, it fails to be of value in answering the study's research problem.

### 1.9.2 Research approach

A descriptive quantitative approach was used in the research as its primary focus of answering "what is" helped answer the research question. It was used in analysing correlations between the stated variables (Jonassen, 2008). This approach was suitable, as the study did not seek to answer why there are misalignments in the current IT audit skill sets and competencies with the desired skills and competencies. Only to prove that such misalignments exist or do not and no attempts were made to manipulate these conditions in the analysis or interpretation of research data (Mertler, 2015:108-111). We did not seek to make inferences as to the "why?" of our research question or extrapolate the results found in the research to be general to the entire

Audit profession, which would have required the use of the Inferential approach to the research (McGregor, 2017; 309-344).

### 1.9.3 Research design

A non-experimental cross-sectional research design strategy was employed in the study using sample surveys in web-based questionnaires using Microsoft Forms. The cross-sectional research design was selected for its ability to allow the researcher to measure the outcome and the exposure of the study participants at the same time (Setia, 2016:261). Participants in the study were selected based on the criteria that they are IT audit professionals in the IT audit, IT risks and controls, IT compliance, IT consulting services, and IT governance landscape of the financial services sector in South Africa, including both males and females, those who belonged to professional bodies such as ISACA and the IIA and those who are not affiliated such professional bodies. While excluding External Audit professionals from the target population due to limitations in the research done on the required skills and competencies and the external audit profession as a whole, even as no major differences are expected (Setia, 2016;261).

This was in line and chosen to be appropriate with the non-probability convenient sampling method as it assisted in "selecting respondents who are convenient or who have volunteered" (Taylor, 2017). The study extracted an estimated 108 participants from the population, which potentially represents the entire population being researched based on easy access and the predicted response rate of the participants in line with the convenience method of sampling (Taherdoost, 2016; Etikan et al., 2016). There was no manipulation done on the variables in the study, just a description and interpretation of the current conditions of the IT audit skills and competencies in relation to desired skills and competencies (Mertler, 2015). The findings are at a point in time, making using other designs, such as Longitudinal studies, impractical (Coffelt, 2017). The study focused on IT audit professionals in IT risks and controls, IT governance and the IT control environments in the financial services sector in South Africa. By focusing on this specific group of professionals, the research gained insights into answering the "what is" of the research problem.

### 1.9.4 Data collection methods

Taylor (2017) developed a table on the "advantages and disadvantages of different data collection methods in survey research".

*Table 1.1 Advantages and disadvantages of different methods of data collection in survey research*

| Type of Survey | Advantages | Disadvantages |
|---|---|---|
| Questionnaires | Relatively low cost.<br>Respondent anonymity may be better preserved.<br>Interviewer bias is not a factor. | Response rate tends to be lower.<br>Any confusion about the question cannot be clarified.<br>Requires literacy skills |
| Mailed questionnaires | Can be completed at the respondent's convenience.<br>No time constraint. | Can be time-consuming.<br>Many follow-ups may be required. |
| Directly administered questionnaires | Take less time.<br>No Mailing costs. | Limits sampling strategies.<br>Less flexibility in time frame. |
| **Type of Survey** | **Advantages** | **Disadvantages** |
| Online questionnaires | Fast<br>Web-based.<br>Administration can incorporate features that paper questionnaires cannot.<br>Data can be directly imported for analysis. | Only people with computers or computer skills can be contacted.<br>Raises concerns over privacy and anonymity. |
| Interviews | Greater flexibility to probe for more detail and administer more complex questionnaires.<br>Ensure the integrity of the questionnaire. | Expensive (personnel and training costs). |
| Telephone Interviews | Potentially short data collection period.<br>Usually cost less<br>Afford more perceived anonymity.<br>Easier to sample a large geographical area. | Less interviewer control.<br>Limited ability to support questionnaires with visual aids.<br>Only people with telephones can be contacted.<br>Opportunity to establish credibility is more limited. |
| **Type of Survey** | **Advantages** | **Disadvantages** |
| Face-to-face interviews | Ideal for contacting hard–to–reach populations.<br>Reduce/eliminate missing data. | Cost of travel.<br>Longer data collection period.<br>Interviewer can be a source of bias.<br>Concerns about personal safety of the Interviewers and lack of respondent anonymity |

Source: Tailor (2017:377)

Looking at these advantages and disadvantages, online questionnaires were designed with sections relating to consent and advanced technologies used in the financial services sector in South Africa. Variables under study will include current IT audit skills and competencies, requisite IT audit skills and competencies, and technological adoption levels within the financial services and within Audit departments.

The surveys were conducted using Online Microsoft form questionnaires. Microsoft forms were selected for their efficiency in collecting and importing the data (Taylor & Doehler, 2014; 36). The Microsoft form questionnaires were sent via ISACA Newsletters and emailed to all ISACA members. An email was also used to reach directly targeted individuals as well as via the LinkedIn chat function, where the link or a QR code of the questionnaire was included in the text sent via these mediums. In contrast, emailed questionnaires only differ because they contain the questionnaire within the email (Lavrakas, 2011), which caused high confidentiality concerns. The researcher conducted the fieldwork alone without assistance because of financial resource constraints.

## 1.10 Data Coding and Analysis

### 1.10.1 Descriptive data procedures

Preliminary data was extracted via a spreadsheet in Excel, where it was imported into SPSS (version 29.0) for further analysis and data visualisation, supplemented by Microsoft Visual Studio Code and Python (version 3.11.5). The data was then coded using components where each component combined aspects of the responses that measured a particular construct and averaged it to categorise the data (Bhatia, 2018). A mixture of measures of central tendencies, correlation, internal consistency and reliability, and analysis of variance was used. These measures of central tendencies were used to summarise and find patterns in the data, internal consistency and reliability measures to evaluate variables as derived from the questionnaire to provide information about the quality and consistency of the data within the specific context of the study questionnaire and inferential analysis to generalise the results and show relationships and variances between the variables identified in the data sets (Bhatia, 2018).

### 1.10.2 Inferential statistics

As defined by Blaxter, Hughes and Tight (2003), inferential statistics is a method of analysing and assessing the importance of the research results obtained based on the data. The analysis was then based on the inferential statistics method and analysis, such as P-P plot of regression standardised residual, ANOVA, Factor Analysis and nonparametric analysis. Further statistical tools were also employed in assessing and analysing the obtained data based on the descriptive statistics analysis and interpretation of the results. Conclusions and recommendations were then derived after the application of these methods.

## 1.11 Thesis Structure

Chapter One serves as an introduction to the study. It provides background information on the topic, establishes the underpinning theory related to the research question, presents the problem statement that highlights the gap in knowledge or understanding and outlines the aims and objectives of the study. Additionally, this chapter includes research questions that will guide the investigation. The research philosophy and design are also discussed here, which may involve identifying whether it is positivist or interpretivist and determining the methodology for data collection.

Chapter two is dedicated to conducting a comprehensive literature review. This chapter explores existing scholarly works and studies related to the skills and competencies of professionals in IT audit, IT risk and controls assurance, IT governance and IT assurance consulting services within the financial services sector in South Africa. The purpose is to establish a theoretical foundation for understanding the phenomenon being investigated and identify any gaps or inconsistencies in previous research.

Chapter three provides an empirical background on the methodology used in conducting the study. It discusses aspects such as research philosophy (e.g., qualitative or quantitative), approach (e.g., case study or survey), and design (e.g., experimental or observational). This chapter also addresses population selection, determination of confidence intervals for statistical analysis, considerations for ensuring validity and reliability, data collection methods employed by the researcher,

data analysis techniques utilised, and ethical considerations associated with conducting the study.

Chapter four delves into the analysis and interpretation of results obtained from data collected during the research process. This involves analysing quantitative data using appropriate statistical methods. The findings are then interpreted to address whether rapid technological advancements have resulted in a misalignment of skills and competencies among IT audit professionals within South Africa's financial services sector.

Finally, chapter five concludes the thesis study by summarising the key findings obtained from the analysis. It also highlights any limitations or constraints faced during the research process and provides suggestions for further research to build upon this study's findings. The chapter concludes by tying together the main points discussed in the thesis. It offers practical implications for practitioners in IT audit within the financial services sector, academic institutions' curriculum, professional bodies' continuous professional development frameworks and organisations' training strategies in South Africa.

## 1.12 Conclusion

In conclusion, this chapter has provided a comprehensive and detailed introduction to the study by successfully setting the stage for this research study by introducing key elements such as background information, theory, problem statement, aims and objectives, research questions, research philosophy and design, methodology for data collection, and structuring of the thesis. This chapter serves as a solid foundation upon which subsequent chapters will build to contribute new insights into the chosen field of study.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1 Introduction

In Chapter 1, the hypothesis that there is a misalignment between current IT audit competencies and skills and the required skills and competencies for the emerging audit environment was established. The chapter provided the background to the hypothesis, where the problem was clarified and why the issue needed to be addressed. It indicated how this study seeks to contribute to addressing the research problem. The aims and objectives were explained while clarifying the approach the study followed in answering the research questions identified. A brief summation of the paradigm foregrounding the study was given. The chapter also looked at the key concepts in this study while providing definitions for each.

This chapter covers the literature review, placing emphasis on the South African context, the history of financial services and its importance to an economy, It establishes what the advanced technologies in the financial services sector are, the legal framework and regulation of the financial services sector and how these technological advances affect IT audit professional's skills and competencies. Lastly, it establishes the nature of skills and competencies that are prerequisite for IT audit professionals in the financial services sector where technological advances have been adopted.

The outline of this chapter is represented by the figure below:

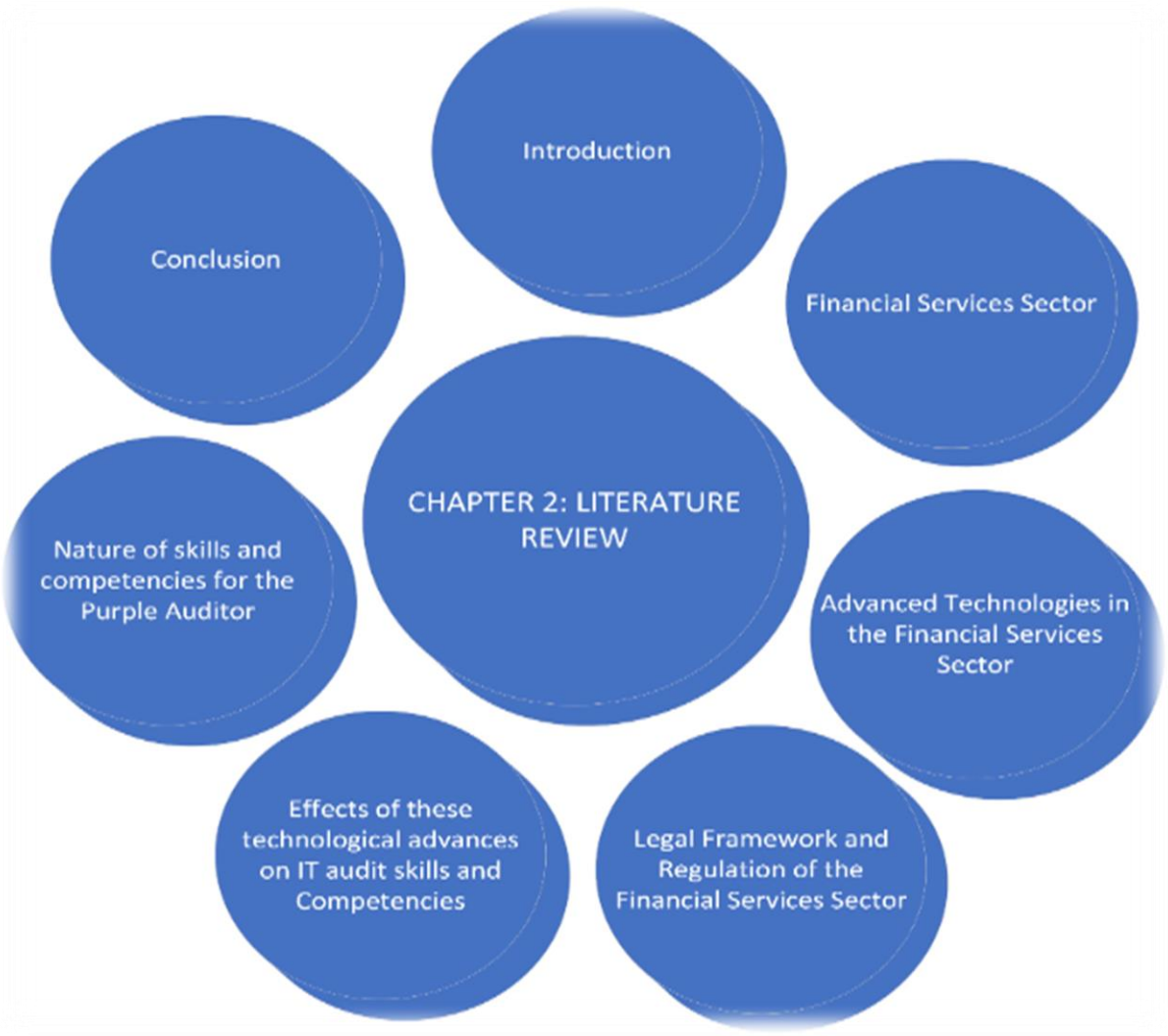



*Figure 2.1 Summary of structure of the thesis*

Technology in the world is evolving at a rapid pace. As human beings, we must evolve with it or risk being left behind and stagnating. Technological changes follow an evolutionary process like biological evolution (Buchanan et al., 2011). This translates to IT audit professionals being required to evolve in skills and competencies as technological advances are being adopted by their organisations to stay relevant and provide quality IT audit services and consultations to their organisations. At the conclusion of this chapter, an analysis and synthesis is derived from the empirical evidence gathered in the literature. A background to the Theoretical framework used in this study is included with supporting literature only in Chapter 3. This will consist of

the framework's rationale, the chosen model that underpins the conceptual framework, and the role this model will have in developing the conceptual framework.

The following search strategy was used to gather the relevant literature:

*Databases*: Mendeley, Emerald, Science Direct, Elsevier, ProQuest, IEEE Xplore, PubMed, ERIC, JSTOR, CPUT (Cape Peninsula University of Technology) Library and Google Scholar.

*Keywords*: Technology advancement, Financial Services, IT Audit, IT Audit quality, Skills, Competencies, Fourth Industrial revolution, Rapid Technology adoption, FinTech.

*Articles included in the search (dates):* 2010 to 2022.

*Limitations of the search*: Only articles written in English.

## 2.2 Financial Services Sector (what it is and its evolution)

The Financial Services Sector is a sector of intermediated services provided to customers through exchanging information and capital (Gupta & Tham, 2018). The history of the Financial Services Sector in South Africa could be traced back to before privately incorporated banks came into existence in 1823. Privatisation of the banking sector in South Africa was brought about by the demands of colonialism's need for a capitalist economy (Verhoef, 2017). However, the financial services sector, particularly banking, started to thrive in 1830. The growth was, however, only in the agricultural prosperity of the region in the Western Cape, known as the Cape Colony during the British colonisation, referred to as the Cape of Good Hope. In the early 1860s, more Imperial banks started operating in South Africa, with The London & South Africa Bank being the first bank to open its doors and Standard Bank after that (Verhoef, 2009).

This sector has evolved a great deal during that time, with 14 locally controlled banks, four foreign-controlled banks, four mutual banks, five cooperative banks, 13 local branches of foreign banks and 29 foreign bank representatives operating in South Africa as of June 2022 (Financial Services Report, 2022). The sector is an important part of the South African economy as it contributes to economic growth. The industries

that comprise the financial services sector could be broken down into those depicted in the diagram below.

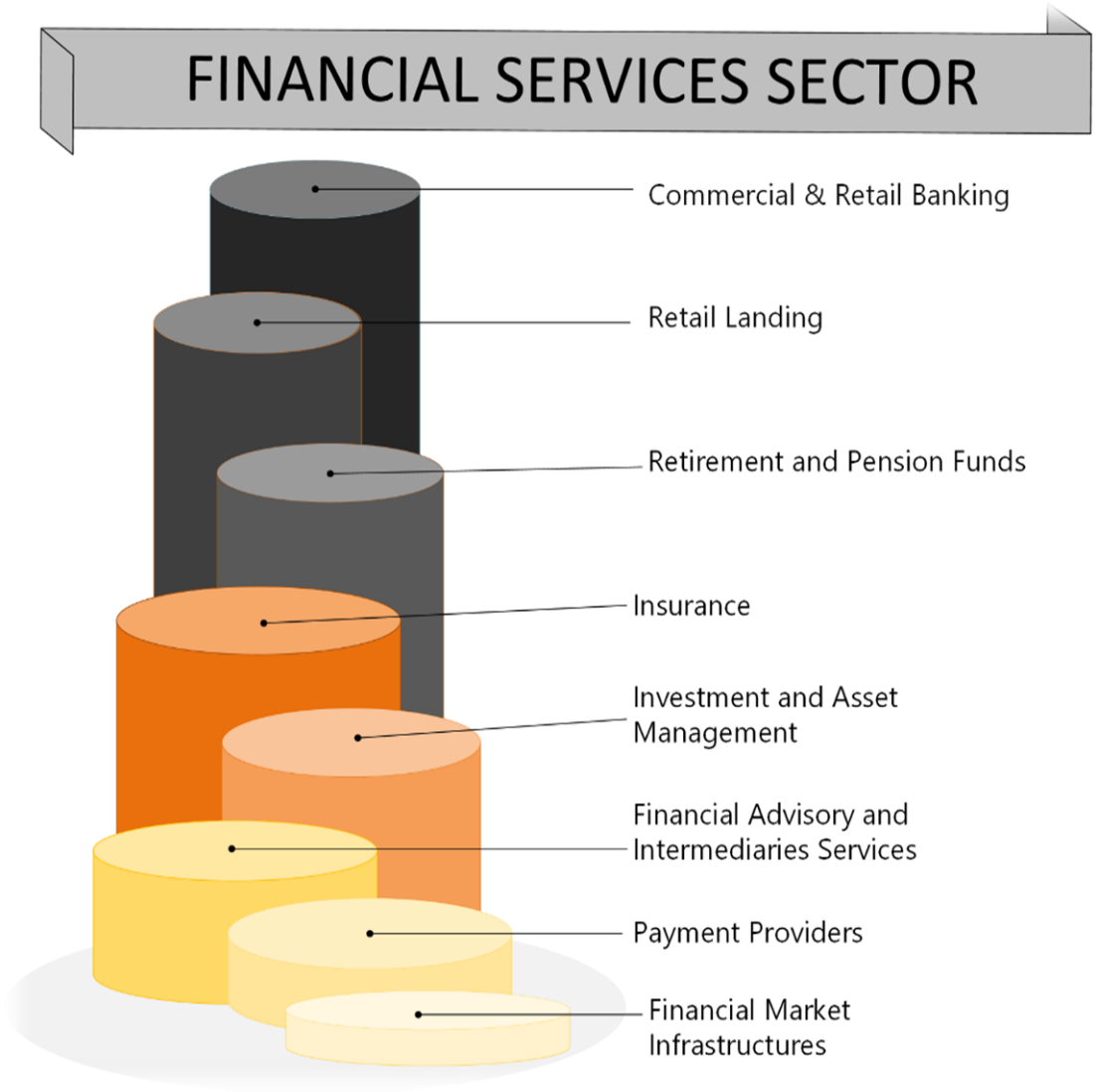



*Figure 2.2 South African Financial Sector*

The Financial Services sector contributes to a country's economy by offering people savings, credit, payment, and risk management services to help increase financial growth opportunities and fight poverty (Makina, 2017). The sector is also an integral part of business efficiency in all aspects of the economy (Newfarmer et al., 2019). It also contributes to people's development and employability, as 55% of its workforce was identified as highly skilled workers (Bhorat et al., 2016). As of 2011, the sector comprised over R6 Trillion in assets, contributing about 10.5% to the country's total GDP (National Treasury, 2011). This has increased to 21% for the first quarter of 2022 (Financial Services Report, 2022).

Technology has greatly improved the traditional financial services sector in recent years. Business models, Customer services and operational processes of financial services have rapidly seen drastic changes through digital transformation into a digital interaction model (Kurmanova et al., 2020). Through Technology advancement in the financial services sector, a new discipline called Financial Technologies (FinTech) emerged. The average growth of FinTech was estimated to grow at an annual rate of 21.1% between 2016 and 2021 (Frischtak, 2019).

Although there has been massive growth in the sector, access from low-income households remains low, with 40% of dormant account holders being individuals from low-income families (Financial Sector Conduct Authority, 2022), and the mode of payment for financial transactions has been predominantly cash. However, Akinboade & Makina found evidence of a move towards a cashless economy (Akinboade & Makina, 2006). This has been evident with the current Reserve Bank initiative through the mandate given to BankservAfrica, the banking sector's clearing partner and official payments system operator (PSO) in South Africa. BankservAfrica is developing a low-cost instant payment system called the Rapid Payments Program (RPP), also known as Payshap. This program comprises three core services: Instant Payments, Request to Pay and Proxy Payments. The first core service, Instant Payments, will facilitate immediate notification and posting of final and irrevocable funds. The second core service of Request to Pay will provide a service that enables customers to request payment from each other digitally, and the third core service will provide a service that allows for payments to happen even without bank account details (BankservAfrica, 2022). This program is designed to be an alternative mode of payment that would be a substitute for cash payments (Financial Services Report, 2022).

## 2.3 Advanced Technologies in the Financial Services Sector

### 2.3.1 Technology in financial services

Empirical literature shows that innovative technology in financial services has not only improved the value proposition for the Financial Services sector but has also created opportunities for financial inclusion for previously marginalised communities. This has greatly assisted South Africa's efforts in achieving sustainable growth (Kostov et al., 2015) and alleviating poverty post-apartheid era.

FinTech is disrupting traditional methods of offering financial services using technology (Arner et al., 2015). Fintech is built upon the LASIC (low margin, asset-light, scalable, innovative, and compliance-easy) principles (Chuen & Teo, 2015). According to Leong and Sung (2018), Fintech can be traced back to 1866 when the Trans-Atlantic transmission cable was used to reduce communication between North America and Europe from 10 days to only a few hours, giving birth to the transition from Analog to Digital communication (Legowo et al., 2021). Since then, we have seen fintech 1.0 with technology-enabled financial solutions such as the TransAtlantic transmission cable, SWIFT and ATMs, fintech 2.0 where digital financial services were taken up to the markets by traditional banks, and currently fintech 3.0 with online automated investment services etc. Some have argued that Emerging markets in the financial services sector are already utilising Fintech 3.5, where mobile money such as M-Pesa in Kenya, Apple Pay and Alipay. (Leong & Sung, 2018), (Legowo et al., 2021) and (Weiyi Cai, 2018) have not only been conceptualised but have already been taken to market.

The competitive environment and the structure of financial services functioning markets are radically disrupted by Fintech, decreasing the need for traditional branch networks of banks and fewer employees needed for business operations while increasing their provision in real-time, creating an environment where low cost through simplifying the systems used in traditional banking is achieved (Kurmanova et al., 2020). The success of Fintech in introducing new business models into the financial system lies in leveraging emerging technologies such as blockchain, Artificial Intelligence (AI), Big Data, RPA, Machine learning, and Cognitive Intelligence (Li et al., 2021).

A few examples of how Fintech is leveraging these emerging technologies are seen in how “essential business operations such as risk assessment, stock trading and credit lending to loan applicants” (Mahalakshmi et al., 2022) are taken over by AI with the late disruptive phenomenon of robo-advisors (Automated Advice in Insurance and wealth Management through AI) (Belanche et al., 2019). AI has enabled customers to get quality advice at a fraction of the costs and with greater efficiency than traditional intermediary/ advisor services offered by their human counterparts (Huneberg, 2020). Blockchain has introduced the concept of smart contracts in financial services, where

software procedures are developed to execute contract terms/ clauses (Jayasuriya & Sims 2021). Blockchain in the financial sector is also useful in areas such as settlements of financial assets, predicting the movements of the financial markets' economic transactions, and offering business-related transactions (Haferkorn & Diaz, 2015). Although this innovative technology is still primarily in the development stages, the current use cases noted by research studies suggest that it will not be long until we see the technology being used in the financial services sector in the near future. Due to the nature and amounts of data financial service institutions, banks, and insurance companies own and transmit daily (Hasan et al., 2020), it has become crucial to understand the insights and trends that can be derived from these datasets to develop predictive models that focus on trends and patterns to make decisions that will help gain a competitive advantage.

Traditional data processing software tools could not initially extract, process, and analyse this data due to the volume and complexity of the data stored by financial services providers. This is why big data has gained popularity in the financial services industry. After the adoption of big data technology by the financial services sector, financial lending decisions through risk analysis, trading, investment and fraud detection (Hasan et al., 2020) are no longer made using the traditional linear, logit and probit regression equations due to evidence of incompleteness found with these techniques (Aziz & Dowling, 2019). This has been supported by Wuerges and Borba, who found that in fraud detection specifically, the logit and probit models that were currently used in literature did not account for undetected fraud cases. Which then rendered unreliable hypotheses where these models have been used in probability analysis of detecting accounting fraud (Wuerges & Borba, 2014).

The other emerging technology poised to disrupt the financial services space, especially in banking, is intelligent automation in building cognitive systems, which the industry, as per Villar and Khan’s assertion, has termed Cognitive banking (Villar & Khan, 2021). Sharma explains cognitive banking as “a cognitive system” that accumulates a large amount of knowledge to give fact-driven advice to both customers and employees (Sharma, 2019). Russ Kliman & Bay Arinze describe cognitive computing as a technology that mimics how the human brain works in solving problems by combining “machine learning, data mining, big data, natural language

processing (NLP), machine vision, robotics, and other artificial intelligence" (Kliman & Arinze, 2018). Research has shown that this new technology would be the next big thing for the financial services sector. Although no evidence could be found in the literature of this technology already being used in the financial services sector, a lot of empirical evidence has pointed to some of its use cases, such as personal banking virtual assistant, improved loan and insurance underwriting, Wealth management chatbot/voice Bot, and predictive call centre services to name a few. This suggests that it will majorly impact the value proposition offered by financial services (Sharma, 2019).

### 2.3.2 Fintech in South Africa

The available empirical evidence also suggests that with the rapid pace of these Fintech-related breakthroughs and disruptors, the financial services industry in South Africa has not been immune, with Le Roux finding 35% of Occupations in South Africa to be potentially automatable (Le Roux, 2018). According to Anton Didenko, South Africa is one of the leaders in Fintech together with Kenya (Didenko, 2017). Each organisation in the financial services sector has had to evolve and adapt to Fintech or risk being left behind by society. In a study he published in 2018, Coetzee found that Nedbank was the number one commercial bank in South Africa that had decreased its branches from 1145 in 2015 to 613 in 2017 (Coetzee, 2018). All this was made possible by digitalising some of their service offerings and changing how they interacted with their clients. South Africa registered its first branchless bank, Bank Zero, with the South African Reserve Bank in 2018. This exclusively digital bank finally launched a limited public offering for individuals and businesses to the market in August 2021 (Buthelezi, 2021). Barbara Jeanne Slazus and Geoffrey Bick confirmed that South African consumers are highly receptive and willing to join a completely branchless bank, with 74% favourable respondents in their paper published in 2022 (Slazus & Bick, 2022). This means that Bank Zero has a value proposition that the market identifies with.

### 2.3.3 Legal framework and regulation of the financial services sector

In South Africa, the regulation of marketing and sale of any financial product is regulated by the Financial Advisory and Intermediary Services Act 2002. The Act came

into effect when it was put in the Gazette 24075 of 15 November 2002. (FAIS Act 37, 2002). According to the Act, the definition of a financial product includes securities and instruments, participatory interest in one or more collective investment schemes, a long-term or short-term insurance contract or policy as defined in the Insurance Act No. 53 of 1998, A benefit provided by a pension fund organisation or a friendly society to its members by virtue of membership, foreign currency denominated investment instrument, a deposit as defined in the Banks Act no 131 of 1998, a health service benefit offered by a medical scheme as defined in the Medical Schemes Act no 131 of 1998 or any product declared by the registrar by notice in the Gazette to be a financial product (FAIS Act 37, 2002). With this premise, FAIS provides the primary overarching regulatory framework for the Financial Services Sector in South Africa. This means that a business needs to be authorised as a financial service provider (FSP) or a financial services representative (under certain circumstances) by FAIS to sell or market any financial product in the South African economy.

To be authorised under FAIS as an FSP, an organisation needs to obtain a license through the Financial Sector Conduct Authority (FSCA) (Tibane et al., 2020). FSCA, through the Financial Sector Regulation Act 9 of 2017's Twin Peaks regulatory model, was established and mandated to "ensure the stability of the financial markets, Drive transformation of the financial sector to improve access, promote fair treatment of financial customers through a robust regulatory framework, provide financial education and literacy in order to have informed customers, and assist in maintaining the efficiency and integrity of financial markets through innovation as the dedicated market conduct regulator (FSCA website, 2022). The following diagram presents the complete regulatory framework landscape for the financial services sector in South Africa.

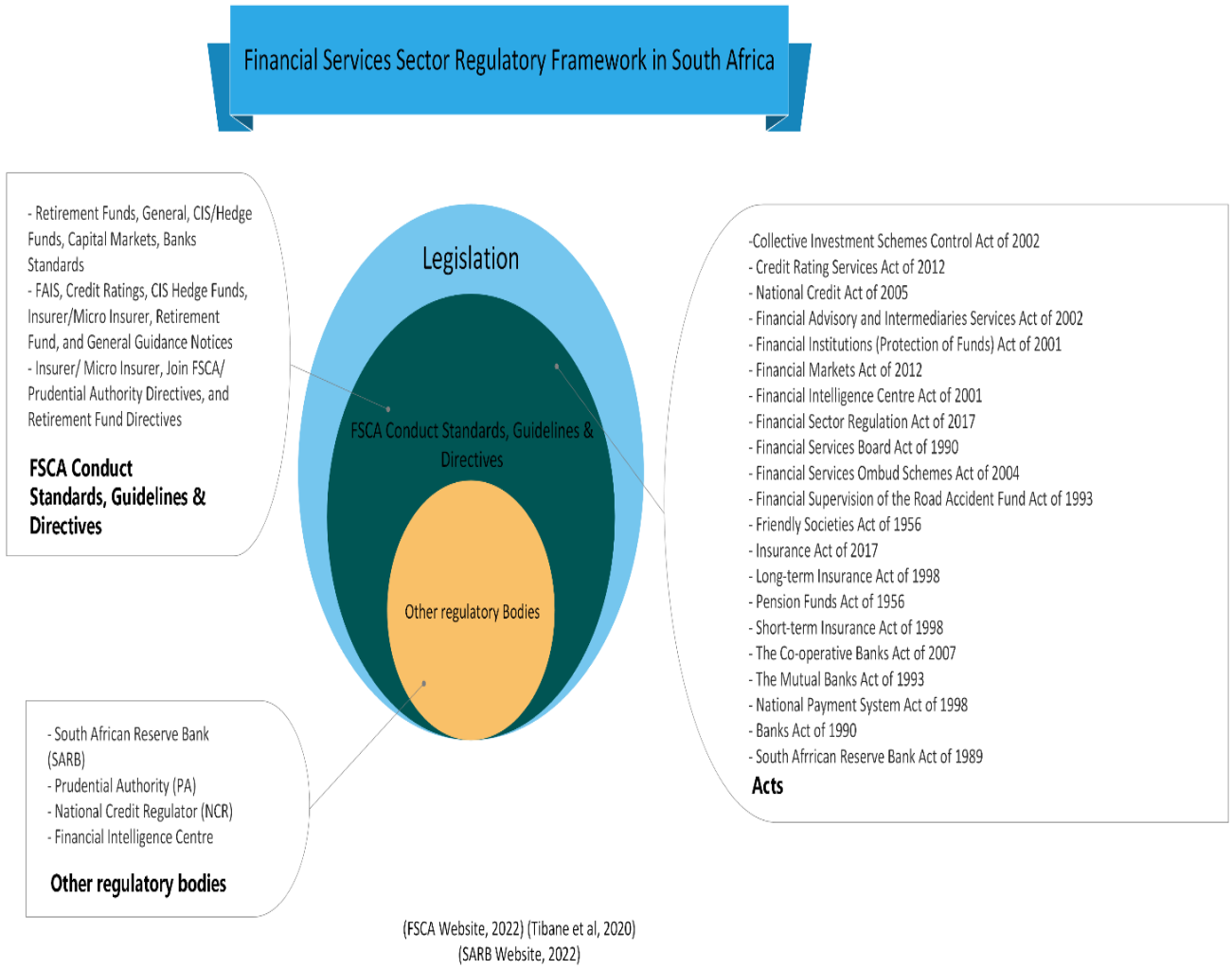



*Figure 2.3 Financial Sector Regulatory Framework*

The payment system plays a major role in the financial services sector and the economy. This requires that appropriate regulations be implemented to ensure national payment systems' efficiency, soundness and safety. The flow of money within the Financial Services Sector relies on the SARB Act of 1989, which mandates the SARB to be the regulatory body for the National Payment Systems, while in turn the National Payment Systems Act grants SARB the authority to recognise a Payment System Management Body (PSMB) which will organise, manage and regulate members participating in the National Payment System by ensuring “the management, administration, operation, regulation and supervision of payment, clearing, settlement systems” (Tibane et al., 2020). The Current PSMB in South Africa is the Payments Association of South Africa. Participation in South Africa’s Payment system requires

members to enter into a Payment Clearing House agreement (PCH). A PCH Systems Operator (PSO) is then appointed by the PCH participants and authorised by PASA to facilitate the clearing of payment instructions between banks and non-banks, of which BankservAfrica is the current licensed PSO. All transactions cleared through the PSO are cleared by the South African Multiple Options Settlement (SAMOS), which is a Real Time Gross Settlement (RTGS) system owned, managed and operated by SARB (PASA, 2021).

### 2.3.4 Regulating Fintech in South Africa

Progress in regulating Fintech in the South African Markets seems to lag compared to other countries with developed financial services markets. The only evidence of regulation designed for fintech activities has been for mobile money through a position paper on Electronic Money NPS 01/2009 published by the South African Reserve Bank (SARB) in 2017 (Didenko, 2017). In 2016, the first ever Fintech regulatory sandbox was established, called the Intergovernmental Fintech Working Group (IFWG). This working group was tasked with exploring how regulators can be more proactive in assessing the emerging risks posed by Fintech on the South African Financial Market (Ukwueza, 2021). This working group consists of all major regulatory bodies in South Africa, such as the Financial Intelligence Centre (FIC), Financial Sector Conduct Authority (FSCA), and the National Treasury, which joined the working group at its conception in 2016, with the National Credit Regulator (NCR) and South African Revenue Service SARS joining in 2019, while the Competition Commission joined in 2020 (IFWG: CAR WG, 2021). While strides have been made in understanding fintech disruptors in the South African financial services space, little progress has been made in developing policies and regulatory frameworks. So far, the position paper on crypto assets published by the IFWG: CAR WG (Intergovernmental Fintech Working Group: Crypto Assets Regulatory Working Group) is South Africa's closest to creating a regulatory framework for Fintech. Even though this position paper only deals with crypto assets and no other forms of Fintech activities in the financial services space (IFWG: CAR WG, 2021). This shows that South Africa realises the importance of understanding Fintech and how to regulate best or modify existing regulations to accommodate these new ways of work.

### 2.3.5 Regulating financial services on the global front

Studies have shown that as rapid technological adoption in the financial services sector grows, the need to revise the regulation of the financial services sector has become significant. This has been prevalent worldwide as countries try to avoid history repeating itself, where governments need to deal with a global financial crisis like the one experienced in 2008 due to poor regulations in the financial services sector. As countries and organisations implemented regulations post the 2008 crisis, such as the Dodd-Frank Act, these regulations have been established on outdated premises that do not consider the Fundamental changes that FinTech has introduced (Magnuson, 2018), such as cryptocurrency changing the very nature of money, Branchless banking and mobile baking changing how banking works, and peer to peer lending and crowd-funding introducing new ways to raise capital (Chorzempa & Huang, 2022). These regulations are relevant and effective in minimising the systematic risk in too-big-to-fail and too-interconnected-to-fail (Wojuk, 2021) organisations, such as large banks and financial institutions. They are designed to make them virtually impossible to implement in Fintech firms as they depend greatly on the centralisations of these institutions that are labelled “systematically important” and, therefore, classified as too-big-to-fail organisations in the financial markets. Fintech firms are generally small and operate in decentralised financial markets, making it difficult to monitor and constrain using these regulations. Using this premise of how these regulations are designed, they will become redundant in no time as traditional financial services and big banks are moving towards being decentralised themselves (Magnuson, 2018).

The 2008 crisis prompted the focus of regulatory bodies to place regulations that focus greatly on systematic risks to avoid a repeat of the past. However, looking at the primary contributors to systematic risks, as established by Magnuson in the diagram below:

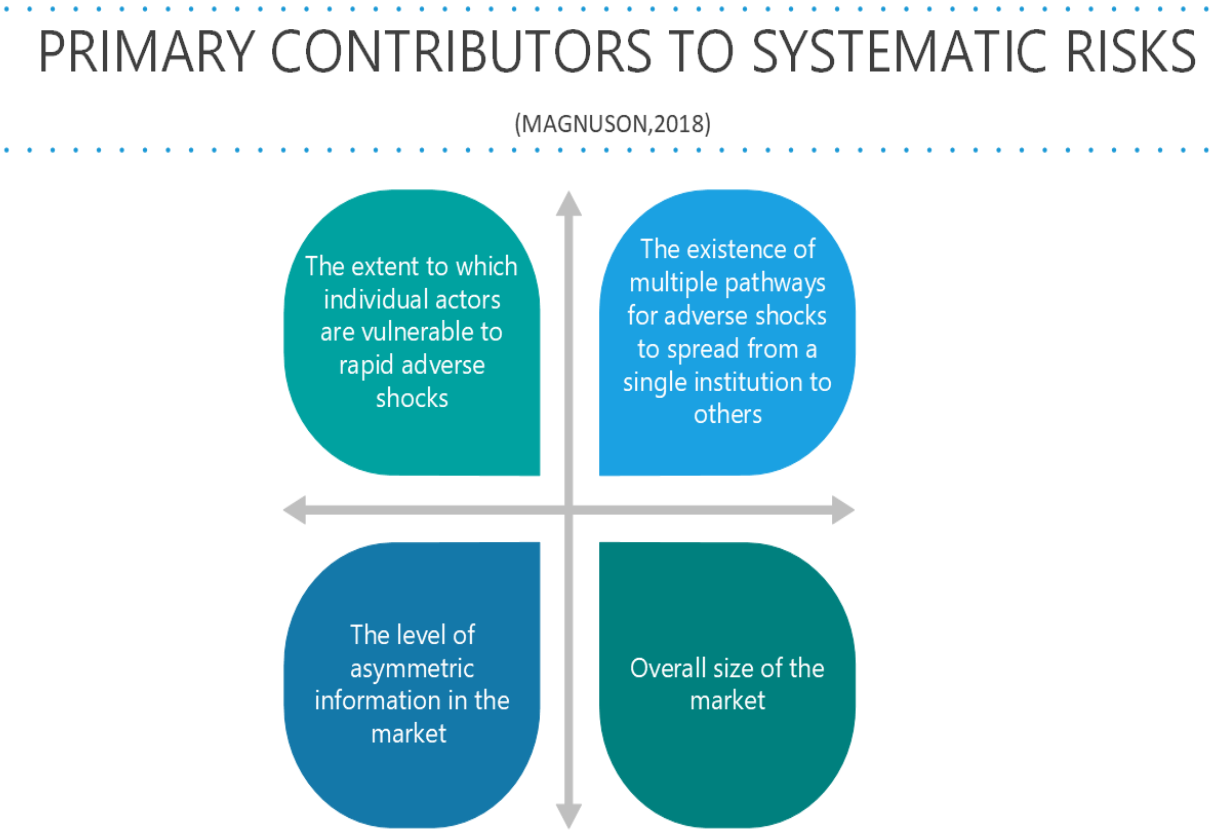



*Figure 2.4 Summary of primary contributors to systematic risk*

One would conclude that the financial markets are heading to yet another financial crisis should the Fintech markets continue to be unregulated as they exhibit most of these contributors currently, save for the overall size of the fintech market, which has not yet reached the proportions that would deem the market too big as compared to traditional financial markets. The Fintech global market size sat at $ 6588780 Million in 2021. It is forecast to reach $ 16652680 Million by 2028 (Anon, 2022), while the global traditional financial services market sat at $22515.17 billion in 2021 (Anon, 2021:21). However, this is rapidly changing, and we could find ourselves blinking and waking up to the Fintech market the size of traditional banks. This fear has morphed into an actual risk with a high probability as just in 2019, there was great uncertainty as to the use of cryptocurrency as a monetary substitute (Clements, 2019), but in 2021, El Salvador became the first country to adopt Bitcoin as a legal tender (Currency) (Wealth Management, 2021). Even with the exploratory use of regulatory sandboxes, which were first embraced by the UK's Financial Conduct Authority (FCA), regulating

Fintech is still excruciatingly far from being a reality because regulatory sandboxes only work based on collaboration (Clements, 2019).

## 2.4 Effects of These Technological Advances on IT Audit Skills and Competencies

### 2.4.1 IT Audit Skills and Competencies

Plant et al. (2013), in their study, noted inconsistencies in how competencies and skills in the available published audit guidance literature (such as the IIA Global Competency Framework and the Internal Professional Practices Framework (IPPF)) have been categorised. However, because their findings do not necessarily impact the definition of what competencies are as provided by the Institute of Internal Auditors (IIA) through its Global Internal Audit Competency Framework published in 2013, defining a competency as “the ability of an individual to perform a job or task properly, being a set of defined knowledge, skills and behavior” (IIA Global Internal Audit Competency Framework, 2013). With Sari’s definition of competence as “a professional skill of an auditor obtained through formal education” (Sari & Susanto, 2018), The study shall concur with the description provided by the IIA Competency framework as an accurate definition of competency. Jason Stanley, in his proposition of the theory of skill, explains skill as “Connected to the kind of knowledge that has the non-reflective characters ascribable by a range of constructions” that is knowing how to do something, knowing when to do something, knowing where to do something, and knowing whether to do something (Stanley, 2017). The ten core competencies prescribed by the IIA on the Global Internal Audit Competency framework include:

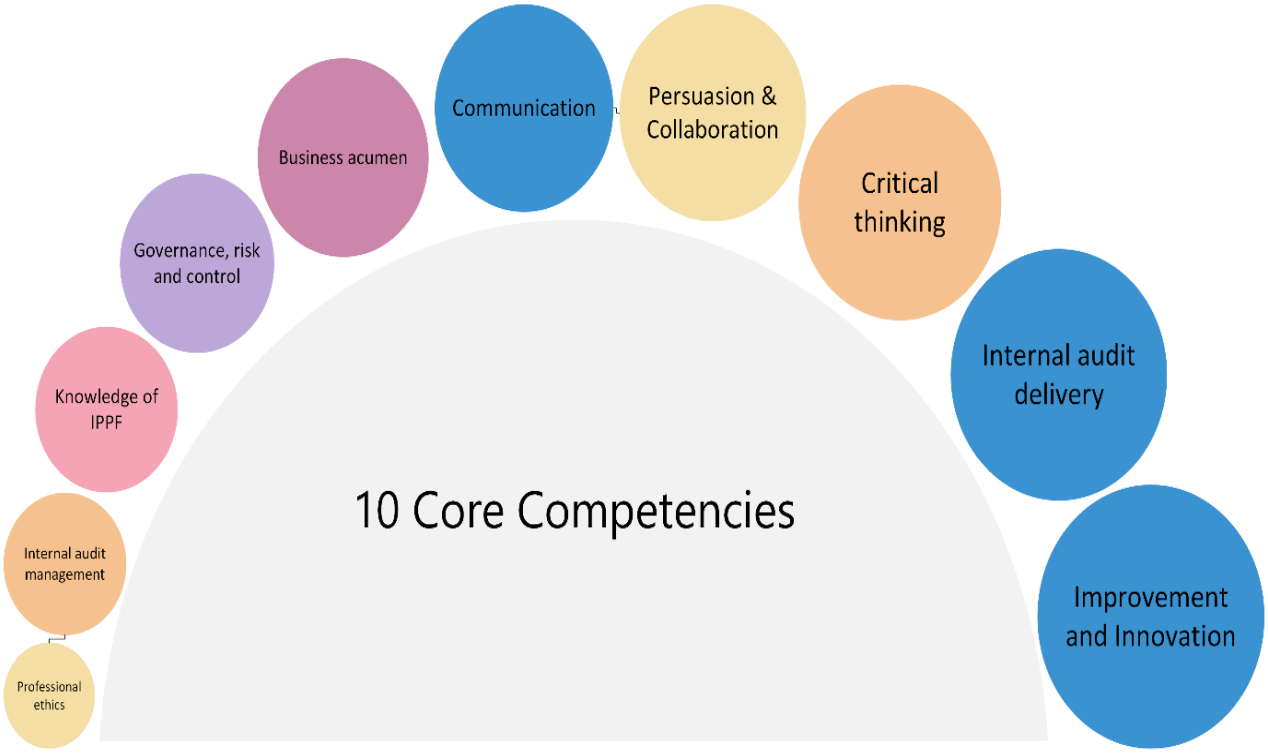



*Figure 2.5 Summary of 10 core competencies*

### 2.4.2 IT professional ethics

IT professional ethics has become important since organisations' operations, governance, and systems moved into Information Technology infrastructures. This is because ethical decisions must now be identified in the IT systems' design, implementation and deployment methods that organisations rely on. IT audit professionals also ensure that these ethical decisions are not overlooked through transparent, objective and independent auditing of these new technologies, how they are designed and implemented, and their deployment methods (Wigan, 2020).

### 2.4.3 IT internal audit management

In performing IT audits, IT-related frameworks such as COBIT, ITAF, ISO/IEC 270001, and ITIL are generally acceptable, and best practices need to be used to improve the audit quality in IT audits (Rosario et al., 2012). Ever since the move to Information technology by organisations, regulatory requirements have shifted to integrating the

control framework elements of general Internal audit into the IT audit assurance framework (Kelson, 2010).

### 2.4.4 Knowledge of IPPF

The IPPF is a framework developed and published by the Institute of Internal Auditors to provide authoritative guidance for the performance and management of the Internal Audit Function (IAF). The framework provides principles and standards for Internal audit practice and detailed mandatory and strongly recommended guidance on how to carry out specific internal audit activities (Anderson et al., 2015) (IIA, 2011). The IIA developed an implementation guide to assist IT internal audit professionals in applying the IIA standards and code of ethics in IT audit assurance called the Global Technology Audit Guide (GTAG), “The GTAG series serves as a ready resource for chief audit executives on different technology- associated risks and recommended practices” (IIA global website, 2022). So far, the following series have been published:

*Figure 2.6 Technology Audit Guide*

### 2.4.5 Governance Risk and controls

IT audit professionals must understand IT governance and what it means for organisations to make appropriate recommendations on improving IT governance processes. They need to know IT risks and how to properly manage them so that they can evaluate how effective an organisation's IT risk management processes are. IT audit professionals must also be knowledgeable in IT internal controls to assess their efficiency and effectiveness in an organisation (IIA, 2014).

### 2.4.6 Business Acumen

Patrick McGuigan describes business acumen as "the capability to bring about positive results" (McGuigan, 2021, p.373). IT audit professionals need to be able to use their talents and business know-how to help the organisation achieve its business objectives (Charan, 2010). Charan further explains that the most important thing in demonstrating the competency of business acumen is to be able to demonstrate judgement (Charan, 2010) by accessing the IT opportunities and IT risks in financial services and be able to apply professional judgement on how these risks need to be controlled based on the know-how of how the industry operates.

### 2.4.7 Communication

An IT audit professional needs to be able to communicate risks and control deficiencies to management and how these can be addressed more effectively. This means that they need to be competent in communication skills, both written and verbal (Plant & Slippers, 2015). When communicating deficiencies and gaps in the organisation's internal controls, the IT auditor must consider their language approach and use a constructive reporting style (Douglas, 2017).

### 2.4.8 Persuasion and Collaboration

Persuasion in an IT audit engagement is used when IT audit professionals try to convince management and auditees to open and communicate with them, accept findings and commit to implementing controls to address them (Wolfe, 2016)

(Perreault & Kida, 2011). Persuasion ensures that IT audit professionals are seen and regarded as there to work with management and the auditees instead of policing them (Brown & Fanning, 2019). To be effective and improve audit quality, IT audit professionals need to be able to collaborate with their fellow Internal audit peers as well as external audit peers. The IIA has proposed this notion, and research studies have been conducted extensively. Researchers concur that collaboration is important for audit professionals to improve audit quality (Weins et al., 2017) (Bianchi, 2017).

### 2.4.9 Critical Thinking

Jenkins explains critical thinking in auditing "as an intellectual skill that enhances an accountant's ability to analyse and solve nondeterministic problems, detect errors and irregularities, and reach sound judgement" (Jenkins, 1998). There are many forms of critical thinking. Brewster and Bucaro, through a review of three auditing studies, summarised that audit professionals need to be able to take a holistic view of the environment under consideration and be able to still focus on the components affecting the environment under review and how these components work together (Brewster & Bucaro, 2020). These sets of skills combined are classified as systems-thinking skills. Systems thinking is another form of critical thinking which is mostly useful in auditing complex environments. The complexity of modern financial services with the introduction of Fintech could overwhelm an audit professional's ability to process information accurately (Brewster & Bucaro, 2020) (Souza & Paz, 2020) if they cannot demonstrate their ability to be critical thinkers (Hasan et al., 2021).

### 2.4.10 Internal audit delivery

As one of the IIA's competency skills, an audit professional must be able to plan, execute, deliver, and communicate audit results to management while also being able to propose practical and logical recommendations that deal with the root causes of issues identified and their impact to an organisation (IIA Global Internal Audit Competency Framework, 2013). By understanding and implementing the IIA's standards, ISACA's standards and guidelines and the GTAG series IT guidance materials in audit engagements, IT audit professionals could demonstrate their skills and competency in producing quality audits (Moeller, 2010).

### 2.4.11 Improvement and Innovation

Changes and improvements in the financial services IT systems, control environment, risk landscape and regulatory frameworks have prompted the need for IT audit professionals to be skilled in innovation strategies in order to perform their tasks; as these tasks have changed, the way they need to be performed has changed, and the auditee's needs have changed (Jacka, 2014). Carawan concurs that for an IT audit professional to be effective, they have to possess the skill to constantly evolve to meet new challenges and seize opportunities (Carawan & Harrington, 2016) to be drivers of change and add value to organisations by ensuring that the organisation is keeping pace with the changing needs of the financial services sector (Jacka, 2014).

## 2.5 Nature of Skills and Competencies that are prerequisite for IT Audit Skills and Competencies

The rapid changes in the environment landscape of the financial services sector towards a "highly automated, highly flexible and highly interconnected environment" (Dai & Vasarhelyi, 2016:8) has resulted in the need for IT audit skills and competencies to change to adapt to these new changes in the environment as the assurance in this new interconnected environment has also changed new knowledge and skills of "inter-object protocols, the objective functions of the interlinked objects" need to be acquired by IT audit professionals (Dai & Vasarhelyi, 2016). Crawford et al. note that the financial crisis of 2008 had called into question the competencies of auditors, especially in auditing banks, has led them to believe that auditors are not demonstrating the requisite professional skills required to be effective and relevant in the new financial services landscape brought about by Technological advancements (Crawford et al., 2011). Simmons is of the view that the adoption of disruptive technologies such as "AI, Machine learning, Software robotics, blockchain, cryptocurrencies, sematic analytics, cloud computing, connected devices and the internet of things" by organisations has resulted in audit skills and competencies being required to change to accommodate these disruptive technologies to be able to assure them. For the Internal Audit Function (IAF) to be able to plan and execute audit plans that are forward-looking to address the new risks that affect new processes brought forward by technological advancement, they need a purple Auditor skilled in technology-heavy skills such as data analytics, data mining, business, and finance

(Engelbrecht et al., 2018) as part of their workforce. This is because to timeously identify, access, and prevent the new risks posed by these new technologies on business processes, a shift needs to be made from the outdated philosophy of backwards-looking audit procedures (Rakipi et al., 2021). Sanglier II has properly articulated that a greater need exists for IT audit professionals to expand their skills (Sanglier II, 2015), and no matter what area of speciality these IT audit professionals have, they must also become proficient with technology and acquire new skills. This is brought about by the demands of the unique risks created by recent technological advancements (Burbidge, 2021). For IT audit professionals to retain the competencies needed to fulfil future needs of the Audit function and keep up with these new technology risks, they need continuous professional development (Cassels et al., 2018).

### 2.5.1 Nature of skills and competencies for the Purple Auditor (Auditor 4.0)

Because of the effect that the auditor's competence and skills have on the quality of the audit (Sari & Susanto, 2018) and due to the technical nature of the new developments in business environments, Bizarro is of the view that first and foremost, future IT audit professionals must have tech-savvy skills and competencies, must be able to think strategically and be strong communicators. IT audit professionals will achieve this by actively trying to understand emerging technologies and continuously expanding their critical thinking and analytical skills (Bizarro, 2019).

*Table 2.1 Summary of Auditors' Competencies*

| Valuable Competencies for Auditors |
| --- |
| **Possessing an analytical, quantitative, and creative mindset** |
| **Applying frameworks and controls to operations and reporting processes** |
| **Developing comfort with advanced technologies such as artificial intelligence (AI)** |

| Valuable Competencies for Auditors |
| --- |
| Communicating findings and making recommendations |
| Demonstrating critical thinking |
| Being curious and exhibiting an inquiring nature |
| Using data mining and extraction methods |
| Understanding database and information management |
| Knowing the organisation and the risks it faces |
| Performing financial and risk analysis |
| Knowing forensic IT Investigation techniques |
| Identifying key data trends |
| Having Industry knowledge and business acumen |
| Being familiar with the organisation’s information systems |
| Interpreting analytical output |
| Showing leadership |
| Understanding math, computer science and business intelligence topics |
| Negotiating when required |

| Valuable Competencies for Auditors |
| --- |
| **Adapting to change** |
| **Building relationships** |
| **Solving problems strategically** |
| **Possessing technical accounting knowledge (e.g., Budgeting, cost, tax etc.)** |
| **Working in intense environments while maintaining accuracy** |

Source: Johnson (2019)

When scrutinising Johnson's list, some of these competencies re-appear from the ten core competencies identified in the IIA Global Internal Audit Competency framework. These include critical thinking, communicating findings, applying frameworks, Industry Knowledge, and business acumen, adapting to change, knowing the organisation and the risks it faces, performing financial and risk analysis, and building relationships. Most of these competencies are more highly technical than soft skills-themed competencies, as highlighted in the top 10 core competencies of the Internal Audit Competency framework. As discussed in the literature in section 3.2, this shift has been brought about by the rapid technological advances that organisations have implemented.

## 2.6 Conclusion

Through the literature evaluated, it is evident that technology in the financial services sector is moving at a rapid pace (Cavallo, 2016). Extensive research has been conducted on these technological advances' impact on the financial services sector and the IT audit profession. These include new business cases being created, such as robo-advisors (Belanche et al., 2019), essential business operations such as risk

assessments, credit lending and loan applications are now being conducted by AI (Mahalakshmi et al., 2022) while financial asset settlements, market predictions and smart contracts can now be made via blockchain (Haferkorn & Diaz, 2015; Jayasuriya & Sims, 2021).

The financial services sector worldwide has had rapid fundamental changes since the introduction of technological advancements. This fact is not only evident in empirical literature but in real-world applications as well. As the phenomenon is most commonly known, Fintech has presented an array of opportunities both for traditional financial services institutions to evolve and stay relevant and for new unconventional players that do not conform to the current status quo to enter the markets. The competition in the financial services sector has been substantially opened compared to the pre-2008 financial crisis. As a developing country, South Africa has not been spared of these changes. However, Fintech has not yet taken the exponential proportions seen in developed countries such as Asia, the European Union and the US. Much has occurred with potential being identified by empirical evidence to have yet to still happen in this arena in the South African financial services space. With these opportunities come a great deal of risk that needs to be addressed to prevent another economic collapse, systematic risk being the all-encompassing umbrella of the risk landscape posed by Fintech. This has left regulatory bodies and countries worldwide scrambling to keep pace with these disruptive changes. So far, it has been observed that these attempts do not follow any sort of framework but are rather on a trial-by-error basis, as seen with the True-lender passed by the Officer of the Comptroller of the Currency (OCC) in the United States in December 2020 and subsequently repealed by the United States congress through its use of the Congressional Review Act of 1996 (CRA) Rule (Savoie et al., 2022). Some countries such as China (Chorzempa & Huang, 2022), Colombia, Morocco (Wojuk, 2021), Bangladesh, Bolivia, Ecuador and Kyrgyzstan (Yussof & Harthy, 2018) have chosen the route of resistance to change with all these countries decisively banning and deeming the trading some forms of fintech activities such as peer- to peer lending, and cryptocurrency as illegal due to lack of regulatory framework use cases.

Regulation of the Fintech phenomenon varies from country to country when looking at its legal status. However, what has been evident in the literature is that this area is

shockingly behind all over the world. The systematic risk presented by Fintech is too great for the financial services markets regardless of which country the markets operate in and therefore warrants that this matter be addressed expediently. In fact, due to the rapid increase in the size of the Fintech market in relation to the traditional financial services market, one might argue that a regulatory framework or frameworks are needed pronto. Whether these be international, per country, region, fintech market segment or Fintech activity is another subject for greater debate. Either way, these frameworks need to be developed. The regulatory landscape for the disruption of Fintech in the financial services sector has since been playing catch up, with most regulations being imposed in a reactive instead of a pro-active approach (Yates, 2018). To try to move away from this reactive approach and to understand better these new technologies and their impact on the regulatory landscape, regulators globally have elected to create sandboxes which allow for a safe and controlled environment for organisations to test their Fintech projects and allow regulators to pro-actively assess the emerging risks that these new Fintech projects pose to the financial services market. This has also been the approach South African regulators took, evidenced by the creation of the Intergovernmental Fintech Working Group (IFWG), established in 2016.

Regulation of Fintech in the South African financial services landscape needs to be structured so as not to stifle the fundamental objective of the country to increase financial inclusion. To efficiently and adequately regulate the rapidly evolving financial services industry, the use of technological tools (now known as RegTech) in the regulatory, monitoring, reporting and compliance has become prevalent (Arner et al., 2017). However, Clement has highlighted the lack of appropriate baseline/frameworks for real-time supervision while ensuring that Fintech firms' operational freedom is the greatest challenge for RegTech (Clements, 2019), emphasising the need for regulatory frameworks to be developed. It is imperative that IT auditor professionals charged with assuring the entire risk landscape of organisations, keep abreast of developments in these areas and subsequently synchronously obtain the skills that is required to independently provide assurance that financial services organisations have effective and adequate internal control processes (IPPF, 2015) guiding them from these risks.

Throughout the literature review, the consistent theme of how technology is changing the business environment has been that auditors must also adapt to these environmental changes. The question has long changed from “Should” IT audit professionals improve their skills and competencies to adapt to these changing environments to “How” they must enhance them. To understand the “How”, the research must look at the “What”; what skills and competencies do IT audit professionals need to stay relevant to organisations that have adopted these rapid technological advancements? The impact of these technological advances has necessitated that technology-based skills be mandatory for IT audit professionals (Coetzee, 2018) (Burbidge, 2021) (Engelbrecht et al., 2018) (Simmons, 2018) (Bizarro, 2019). To obtain these skills and competencies, continuous professional development plays an integral role (Cassels et al., 2018). This is because IT audit professionals need to be constantly evolving at the rapid pace that technology is moving (Betti and Sarens, 2020) to be proactive instead of reactive in identifying the new challenges and opportunities that these new technologies present to organisation’s bottom line (Carawan & Harrington, 2016) and developing audit procedures that are more forward-looking (Rakipi et al., 2021).

Standard setters that guide IT audit professionals have started to investigate the skills gap introduced by technology. Through research studies such as Johnson’s study, IT audit professionals know what skills and competencies are needed to be effective and add value to organisations (Johnson, 2019). A new report released by the IIA’s Internal Audit Foundation in collaboration with Deloitte assessed the internal audit competency using the IIA’s Global Internal Audit Competency Framework and identified key insights where gaps in the competencies and relevance of audit professionals are highlighted. The study confirmed that Internal audit professionals have the core competencies prescribed by the IIA’s Global Internal Audit Competency Framework. However, gaps were found where technical competencies such as data analytics, IT control frameworks and fraud were identified (Anon, 2021). This report and the literature examined have the same consistent message that the speed at which technology is evolving has impacted the nature of risks and how the business world operates, and this, in turn, has demanded that IT audit professionals have adequate skills and competencies to keep up and stay ahead of these changes (Bizarro, 2019). IT audit frameworks and standards have been developed based on industry best

practices, which need to be understood and implemented by IT audit professionals. To implement these frameworks effectively, they must be tech-savvy and strategic thinkers (Bizarro, 2019). However, Kend & Nguyen have noted that these standards and frameworks might not be in line with the current IT and automation that has so far taken place due to regulators and standard setters failing to keep track of these technological advancements and how they would affect the audit profession (Kend & Nguyen, 2020).

To conclude, by applying Johnson's words, purple auditor "competencies and their related hard and soft skills can no longer be viewed as optional. They are necessary for audit professionals at all stages of their careers" (Johnson, 2019, p. 56). This will inform the basis with which the study can investigate the hypothesis that IT audit professionals do not currently possess the skills and competencies needed to provide quality assurance by the auditor of the future as we is investigating whether IT audit professionals have acquired these skills and competencies and determine the rate at which IT audit professionals in the financial services sector, particularly in South Africa, are developing these skills and competencies.

# CHAPTER 3
# RESEARCH METHODOLOGY

## 3.1 Introduction

Chapter 2 reviewed the literature covering the financial services sector, advanced technologies in the financial services sector, and the legal framework and regulation of the financial services sector in the new digital age. It extended to the effects of these technological advances on IT audit skills and competencies and the nature of skills and competencies required for the auditor of the future, known as a purple auditor. The consulted sources included local and international publications such as books, Journal articles, book chapters, company websites and other related research publications through online databases. The strategy used to search for resources has been discussed in detail.

This chapter looks at literature that will provide a synopsis of the research methodology chosen for this study, accompanied by an empirical study where a questionnaire consisting of 49 questions is completed by IT auditors, IT audit practitioners, Internal Auditors whose functions include providing assurance on IT information systems, IT risk, IT controls, IT governance as well as consulting services and placing a focus on those in the private sector particularly Financial Services and banking industry. This is to try to answer the main research question: "Is there an alignment between the skills and competencies that IT audit possess, and the skills and competencies required by technologically advanced organizations?". This chapter outlines the research methodology used when attaining the data from the participants of this study.

## 3.2 Research Methodology

The research methodology, as explained by Mukherjee, is "like a strategy encompassing principles, processes, procedures and techniques to seek a solution to an identified research problem" (Mukherjee, 2020:20). By this construct, the path to finding answers to research questions constitutes a research methodology. Research methodology is based upon the rigorous, systematic, valid, verifiable, empirical and critical step-by-step approach to a research enquiry, with each step providing a variety

of methods, models and procedures (Kumar, 2011). The methodology comprises the methods and approaches used: data collection, data analysis and interpretation of observations to the dissemination of the research findings (Mukherjee, 2020).

The first step in research methodology is determining the research design. This is the "plan, structure, and strategy so conceived as to obtain answers to research questions or problem" (Kumar, 2011). A research design should be chosen based on its capability to assist the researcher in answering questions validly, accurately, objectively and in an economical manner (Kumar, 2011). Johnson and Christensen (2014) state that there are three major research designs: quantitative, qualitative, and mixed.

### 3.3 Research Philosophy

In scientific research, there are philosophical underpinnings in how we can understand and articulate beliefs about the nature of reality, what can be known about reality and how we attain this knowledge (Rehman & Alharthi, 2016). Their philosophical underpinnings are called research paradigms. They describe a paradigm "as a basic belief system and theoretical framework with assumptions about ontology, epistemology, methodology and rigour (Rehman & Alharthi, 2016). Three major research paradigms guide scientific discoveries: positivism, interpretivism, and critical philosophy. The first person who developed the positivism philosophy was Auguste Comte, who, through his rationale and discussion, advocated that a positivist in scientific research, especially that of the social sciences, judges all historical actions of the world and humans in relativity but does not justify them in a random, unsystematic manner (Comte, 2022).

In the philosophical assumption of positivism, humans are not questioned as to how they arrive at knowledge, meaning what it means for things to exist or how things exist, but places its focus on how we know they exist. Positivism laws, even those of nature, are tested against collected data systematically to generate and validate such laws (Coolen, 2012; Turner, 2001; Kolakowski, 1972; Crossan, 2003). Rehman and Alharthi (2016) postulate that interpretivism's view is that of multiple socially constructed realities. They argue that in interpretivism, the existence of multiple knowledge is accepted because interpretive research aims to try to understand the data and what it

has to say about the phenomena under study. This was supported by Ryan Gemma (2018), who stated that interpretivism is subjective in evaluating how humans know certain truths and knowledge exits. Critical philosophy believes that knowledge exists but has been shaped by cultural, political, ethnic, gender and religious factors (Rehman & Alharthi, 2016) and that experience alone renders the foundation for cognitions (Hegel, 1975).

For this study, the positivism paradigm was employed. This is because positivism adopts a clear quantitative approach to investigating phenomena (Crossan, 2003). This has been deemed the most suitable approach as it would assist the researcher to focus on explicit knowledge (Turyanhikayo, 2021) and ultimately achieve the researcher's belief in employing objective facts without being part of the reality or influencing the research outcomes. It also focuses more on hypothesis testing through data collected systematically making it the suitable philosophy to employ in proving or disproving the main research question that "rapid technological advancements has created misalignments of skills and competencies of IT auditors in the financial services sector in South Africa."

## 3.4 Research Approach and Design

The difference between research approaches and design, apart from philosophical stance and conceptual underpinnings, is the intention or purpose of the study (Schneider & Fuller, 2018). The following sections provide explanatory notes on the three approaches commonly used in social science and business research.

### 3.4.1 Quantitative research

The quantitative research approach relates to the research that uses quantitative research methods. It relies primarily on collecting numerical data to answer research questions (Williams, 2007) (Johnson & Christensen, 2014), focusing on testing hypotheses and theory. Quantitative research can be classified into three broad categories: descriptive, experimental and causal-comparative. Descriptive research entails identifying a phenomenon's attributes on an observational basis or exploring the correlations between two or more phenomena. At the same time, experimental research investigates the treatment of an intervention in the study group and then measures the outcomes and the treatment. Then, in causal-comparative research, the

independent variables are examined as to how they are affected by the dependent variables involving cause and effect relationships between them (Williams, 2007). Quantitative research approaches are specific and well-structured and have been tested for their validity and reliability (Kumar, 2011).

### 3.4.2 Qualitative research

Qualitative research relies on collecting non-numerical data such as words and pictures. It focuses on understanding a research question or problem as a humanistic or idealistic approach (Pathak et al., 2013). According to Williams, one of the identifiers of qualitative research "is the social phenomenon being investigated from the participant's viewpoint" (Williams, 2007). There are five categories of qualitative research: case study, ethnography study, phenomenological study, grounded theory study, and content analysis. Ethnographic research involves examining cultural knowledge by collecting data from a cultural group using different methods, including observation, interviews and document reviews to arrive at a comprehensive description of the cultural group and their viewpoints (Vishnevsky & Beanlands, 2004). Case study research is defined by Johnson and Christensen (2014:580) as "research that provides a detailed account and analysis of one or more cases" by trying to learn more about a little-known or poorly understood situation. This is achieved by collecting extensive data drawn from multiple sources, such as direct or participant observations, interviews, physical artefacts, archival records, and audio visual materials (Williams, 2007). Phenomenology research examines people's specific life experiences. The underlying philosophy of this type of study is that humans are integrated with the environment; thus, how they view reality is subjective to each individual's experiences (Vishnevsky & Beanlands, 2004). Data is collected through lengthy interviews that will identify common themes in people's perceptions of their experiences (Williams, 2007). Qualitative research is useful when little is known about a topic or phenomenon and when a researcher wants to discover or learn more about a specific phenomenon (Johnson & Christensen, 2014). Grounded theory research, according to Williams, "is the process of collecting data, analyzing the data, and repeating the process, which is the format called constant comparative method" (Williams, 2007). In grounded theory research, theories are inductively developed based on data that has been systematically gathered and analyzed (Johnson & Christensen, 2014). Content

Analysis research entails collecting and organizing data to draw realistic conclusions. The main purpose of content analysis is to describe all variations, patterns, behaviours, and themes in a phenomenon, a situation, or an event, with no attempts at quantifying the variations identified (Kumar, 2011).

### 3.4.3 Mixed method research

This method systematically combines ideas, approaches and techniques from quantitative and qualitative research into a single research study. This method of research focuses on the strengths that can be derived from quantitative research and qualitative research while minimizing the weaknesses of each of these research methods (Migiro & Magangi, 2011) (Johnson & Christensen, 2014) (Williams, 2007). Mixed research allows for a research design that combines data collection and data analysis methods from the quantitative and qualitative research approaches, enabling the researcher to test and build theories simultaneously (Williams, 2007).

## 3.5 Research Design

Following the research problem and questions, the next step was determining how the study would collect evidence, what evidence is needed to answer the research question, and the location and means of effectively obtaining the evidence. These questions led to the design choice for the study (Vogt et al., 2012). This study has chosen the descriptive survey design as it was the best fit to answer the current state of "what is" (Knupfer & McLellan, 1997) as that is the main reason for the study. Survey design is a process that involves various elements that are interdependent to each other, namely the sampling methodology design, survey methodology design and survey instrument design (Stopher, 2012). This study was considered descriptive since it aims to prove or disprove a phenomenon that is said to be in existence. Therefore, in this study, a descriptive quantitative approach is taken using a non-experimental cross-sectional design where web-based questionnaires is used as the data collection instrument, as participants is chosen based on pre-determined criteria. No attempts at manipulating the variables is made, and findings are as at a point in time.

## 3.6 Population

A population is defined as the entire group of participants from which a researcher attempts to draw conclusions, while a sample is a subset of the entire group that the researcher will use to draw those conclusions and generalize about the entire population (Tillé, 2006). The targeted population for this study was IT auditors, IT audit practitioners and internal auditors whose functions include providing assurance of IT information systems, IT risks, IT controls, IT governance, and consulting services employed in the financial services sector in South Africa. This population included males and females, those who belong to professional bodies such as ISACA or the IIA, and those not affiliated with such professional bodies. The population specifically excluded professionals in the external audit domain.

## 3.7 Sampling

A non-probability convenient sampling method was used in selecting a sample size of 108 respondents. This was because the study is specific to one identified profession and one sector and because the respondents could be assembled conveniently using the ISACA South Africa chapter database of professionals in the specified field (Fink, 2002).

### 3.7.1 Confidence interval level of this study

When using sampling in a study to make a generalized inference regarding a general population, the researcher must use the estimates of error and sample statistics to get an idea of the population parameter as a range of values based on a desired confidence level. This is called the confidence interval (CI) (Hazra, 2017). In order to get to the confidence interval, a confidence level needs to be decided by the researcher. The most used Confidence levels are 90%,95%, and 99%. For this study, a confidence level of 95% was selected based on the sample size sampling method (Kothari, 2004; Cochran, 1977; Rosner, 2015).

### 3.7.2 The margin of error for this study

No matter how proficient a researcher is, there will always be a margin of error or bias in the sample, which might arise not only with the procedures and situations outside

of the sampling process initiated but also from external sources (Fink, 2002). This is to say that no matter how accurate and efficient the sample size is assembled to represent a model of the population, the samples will contain errors. The margin of error is how much the "sample varies, by chance, from the population (Fink, 2002). The margin of error can be calculated using the following formula;

**Margin of error (Statistics) = Critical value x Standard error of the sample**

Using this formula, the margin of error for this study with the elected sample size of 108 respondents is 1.96*3.0 = 5.88

### 3.7.3 Validity and reliability of the survey instrument

A good survey provides critical insights, themes, relationships and trends on the research problem being investigated. A survey is only deemed good if it produces reliable, reproducible and valid data (Litwin, 1995). To ensure that the questionnaire used to collect data from respondents contained questions that would assist in obtaining the desired data, the questionnaire was pilot-tested with four respondents who were asked to complete the questionnaire and provide feedback as to their assumptions on the level of user-friendliness of the questionnaire (Litwin, 1995). Based on the feedback received and the survey data obtained from the pilot, it was confirmed that the questionnaire was clear, concise, professionally designed, easy to complete and able to obtain the required data to answer the research question.

Furthermore, this study asked the following delineation questions in the questionnaire: "Are you currently working in the Financial Services/Insurance Sector?" The questionnaire will only be distributed to the ISACA member database, ensuring that only IT audit professionals or those working in IT governance, IT risk, IT controls, IT information systems assurance and IT assurance consulting services are selected.

## 3.8 Data Collection

The data was collected from ISACA's membership database, focusing on members in the financial services sector who either hold IT audit positions or work in Internal Audit whose functions include providing assurance on IT risk, IT controls, IT information systems and IT governance. This section describes the paradigm of positivism in

employing a descriptive quantitative approach to the main research question. The population, sampling technique, and procedure for selecting the respondents is explained. In the conclusion of the chapter, an outline of the demarcation of the study area and the ethics considered in the study is outlined.

The questions developed in the questionnaire design were organized according to the following sections:

**Part 1: Biographic Information & Employment History**

This section aimed to establish the biographic background of the respondents and ensure that all the respondents met the delineation criteria. That is to say, if any portion of this section fails to meet the delineation criteria, the survey is terminated, and the survey results is excluded as the questionnaire is deemed invalid.

**Part 2: Acquired Audit Skills and Competencies.**

This section aimed to ascertain the audit skills and competencies acquired by the respondents in the years they have been in the profession and their level of competence.

**Part 3: Knowledge and Competence with Advanced Technologies**

This section aimed to ascertain respondents' level of knowledge and competence with the chosen list of advanced technologies and the level of adoption of these technologies in their respective organizations.

## 3.9 Data Analysis

The data collected from the survey research was analyzed and visually represented using SPSS (version 29.0) as the primary tool for analysis, with supplemental aspects of analysis conducted using VS code 2023 and Python (version 3.11.5) to make it easy for the data to be easily understood, analyzed and compared. The data was coded by assigning codes to potential responses for each survey question and making use of buckets grouping with data groups in buckets based on age, skills, competencies, knowledge of new technology advances, and levels of implementation of technology advances.

To analyze the data and find patterns, a mixture of measures of central tendencies together with correlation, analysis of variance, P-P Plot of regression standardized residual analysis, nonparametric analysis, Factor analysis, and internal consistency and reliability analysis was used in both the descriptive and inferential statistical analysis.

## 3.10 Limitations of This Study

This study used a sample of respondents with IT audit skills and competencies working in the Financial Services sector and residing in South Africa. With all that in mind, the study still seeks to generalize the findings to the whole IT audit discipline in South Africa. This may compromise the credibility of the research, looking at how the study only focuses on one sector of the South African economy. The other barrier that might affect the study outcomes is the continuous new skills and competencies that might arise in the industry soon after the completion of the study, rendering the research outcomes incomplete or absolute. In order to try to mitigate or reduce the probability of new skills and competencies drastically impacting the study negatively, the study was concluded within three years. Considerations of new skills and competencies that may arise with significant implications to the research outcomes were considered and

included within the research, whether during data collection, data analysis and conclusion of the study.

### 3.11 Ethical Considerations

Ethical research is conducted with moral principles underpinning how the study was conducted. Some of the most significant principles in research ethics are the honesty applied in achieving and presenting results, ensuring that respondents are not harmed by obtaining informed consent from the respondents, only allowing participation voluntarily, ensuring the privacy and confidentiality of the respondents' data, and making sure that respondents maintain their anonymity when the results of the study are presented (Creswell, 2003) (Sandu et al., 2019). The questionnaire was designed to include a consent form as the first section of the questionnaire. The questionnaire was designed to not go to the second section without the consent questions having been answered and signed by the respondents. Respondents were also assured that their responses would be handled with strict confidentiality and analyzed anonymously. Each respondent's personal information was treated with confidentiality by structuring the survey and interview questions in a manner that does not allow direct identifiers to be recorded in the responses.

Anonymity was maintained by removing unnecessary information that may identify participants with their responses. The researcher carefully explained to the participants why the research was important and that they could pull out at any point in the survey if they so wished. The data collected was stored on OneDrive, a cloud-based storage solution accessed with a username and password only known to the researcher with a user account belonging to the Institution and not the researcher's OneDrive account. The data was accessed and analyzed using a laptop with anti-virus software and is used exclusively by the researcher, protected with a different username and password. Observation of protocols were paramount in this study to observe COVID-19 restrictions and university rules and regulations. Stringent data storage and handling measures were applied to ensure confidentiality. The researcher was transparent, accountable and honest with the respondents throughout collecting data. Refer to appendix D for the ethical clearance obtained for the research.

## 3.12 Summary

This chapter gave an account of the research approach and design used for this study while also providing empirical evidence of the different approaches and designs that a researcher could follow to support the reasons and give base as to why a descriptive quantitative research approach that followed a non-experimental cross-sectional research design strategy underpinned on the positivism paradigm was chosen for this study. The different data collection methods were briefly discussed and outlined, including the population and the sampling frameworks that were followed using empirical literature to highlight the meanings and importance of each method. The research approach and designs, population and sampling frameworks used for this study were briefly explained and outlined. The chapter went into further detail in highlighting the confidence interval and the margin of error underpinning this research study. The descriptive survey questionnaire data collection tool which was used was explained. A brief discussion on how the data is analyzed and the tools and instruments used for analyzing was explained. Lastly, a brief discussion on the limitations and ethical implications of the study was detailed. In Chapter 4, the Data analysis and report of the data collected is provided in detail.

# CHAPTER 4
# DATA ANALYSIS AND INTERPRETATION

## 4.1 Introduction

This chapter is dedicated to the analysis and interpretation of the collected data. The chapter is structured as follows: firstly, a description of how the data was collected and prepared for analysis; secondly, a general overview of the collected data, followed by a presentation of the hypothesis. The data is analysed, and the results are interpreted. Finally, a summary of the findings observed within the study is provided.

As stated in Chapter 1, this study aims to investigate whether IT audit professionals possess the necessary skills and competencies that align with the demands of emerging audit environments in today's technologically advanced landscape. Based on an examination of available literature, the adopted hypothesis posits that there is a misalignment between current IT audit skills and competencies and those required for emerging audit environments. To achieve the research objectives, we have formulated one main research question, which has been further divided into seven sub-questions, as detailed in Chapter 1. In Chapter 2, two of these sub-questions were addressed through an evaluation of existing empirical literature. These sub-questions focused on determining what skills and competencies are considered essential for delivering quality IT audits in the financial services sector in South Africa. The remaining five sub-questions will serve as the basis for this chapter.

## 4.2 Preparation of Data

The data was collected utilising Microsoft Forms, and the responses were subsequently downloaded as an Excel file. In order to facilitate analysis, all acquired data must be inputted into the chosen program as numerical values. For this study, SPSS (Version 29.0) was employed as the primary tool for analysis, with supplemental aspects of analysis conducted using VS Code 2023 with Python (version 3.11.5). This procedure involves a process known as coding, whereby numerical codes are assigned to potential responses for each survey question (Lutabingwa & Auriacombe, 2007). In the preparation of the data for coding, the following steps were performed:

The survey responses were extracted from Microsoft Forms and imported into an Excel spreadsheet named "Dataset.xlsx". The dataset columns corresponded to the research questions outlined in the survey questionnaire, while the dataset rows represented the responses obtained for each question.

Data manipulation was performed to eliminate redundant columns automatically imported from Microsoft forms, such as blank standard columns. Additionally, columns containing irrelevant data, including the time when respondents initiated the survey (Start time) and unique response identifiers (ID) associated with each respondent, were removed. This process was executed using a Microsoft Visual Studio Code 2023 script and Python Pandas version 3.11.4. Refer to Figure 4.1: Remove blanks Python code in Appendix A for the actual code.

The columns of the Dataset were subsequently renamed to align with the assigned variable names for analysis purposes, employing Microsoft Visual Code Studio and Python Pandas. The file was then saved under a new name and exported into an Excel file by executing the ensuing script. Refer to Figure 4.2: Rename Columns Python code in Appendix A for the actual code.

The survey was tailored exclusively to IT audit professionals operating within the Financial Services sector in South Africa. To maintain a focused dataset, all responses where participants indicated a negative response to question 10 of the Survey, which inquired about their current employment in the Financial Services/Insurance Sector (including auditing clients), were expunged. Subsequently, a modified version of the dataset was saved under "FinancialServicesDataSet.xlsx". This process was facilitated by executing a Python script within Microsoft Visual Code Studio. Refer to Figure 4.3: Filter to "FinancialServicesEmployees’=’Yes’ Python code in Appendix A for the actual code.

The subsequent variables were then encoded using the SPSS software. The data about the Soft skills and competencies acquired by IT auditors was labelled as "Soft Skills and Competencies", while the acquired technical skills and competencies specific to IT auditing were labelled as "Technical Skills and Competencies". The amalgamation of soft and technical skills and competencies was denoted as "ITAuditSC". The level of knowledge and usage experience for each of the 12

identified technological advances (Robotics Process Automation, Machine Learning, Artificial Intelligence, Process Mining, Advanced Analytics, Data Mining, Blockchain, Machine Language processing, big data, Drones, Nanotechnology, and Internet of Things) was coded as LOKSCT. Additionally, the level of adoption of these technologies within the broader organisation was coded as LOAO, while the level of departmental adoption was coded as LOAD (refer to Table 4.1). Each variable within these composite categories was scored on a scale of 5 to 1. A score of 5 indicated a high level of competence, knowledge, or adoption, whereas a score of 1 represented a lower level. As such, there was no necessity to reverse code or normalise the scores.

*Table 4.1 Code Book*

| Code | Composite Measures |
|---|---|
| **LOAD** | Level of Adoption of the Technology in the Department |
| **LOAO** | Level of Adoption of the Technology in the Organisation |
| **LOKSCT** | The Level of Knowledge, Skills and Competencies in using the Technology. |
| **ITAuditSC** | Level of Skills and Competencies for the top 23 It audit skills and competencies identified. |
| **Soft Skills and Competencies** | Level of Soft Skills and Competencies identified to be relevant for IT auditors. |
| **Technical Skills and Competencies** | Level of technical skills and Competencies identified to be relevant for IT Auditors. |

The subsequent procedure involved the computation of Composite scores. To accomplish this, the scores for each item were calculated by averaging the normalised scores associated with each item belonging to a respective composite. The SPSS Transform compute variable function was employed to perform this calculation. Please refer to Table 4.2: Composite sub-variables for specific variables included in each composite.

*Table 4.2 Composite sub-variables*

| **Composite Measures** | | | |
|---|---|---|---|
| **LOAD (Question 49: Level of adoption on a departmental level)** | | LOAO (Question 48: Level of Adoption on an Organisational Level) | |
| **Code** | Description | Code | Description |
| **RPA3** | Robotics Process Automation | RPA2 | Robotics Process Automation |
| **ML3** | Machine Learning | ML2 | Machine Learning |
| **AI3** | Artificial Intelligence | AI2 | Artificial Intelligence |
| **Process Mining 3** | Process Mining | Process Mining 2 | Process Mining |
| **Advanced Analytics 3** | Advanced Analytics | Advanced Analytics 2 | Advanced Analytics |
| **Data Mining3** | Data Mining | Data Mining2 | Data Mining |
| **Big Data3** | Big Data | Big Data2 | Big Data |
| **Internet Of Things3** | Internet of Things | Internet Of Things 2 | Internet of Things |
| **Nano technology3** | Nano technology | Nano technology 2 | Nanotechnology |
| **Drone3** | Drones | Drone2 | Drones |
| **BlockChain 3** | Block Chain | BlockChain2 | Block Chain |
| **Machine Language Processing 3** | Machine Language Processing | Machine Language Processing 2 | Machine Language Processing |
| **LOKSKT (Question 47: Level of Knowledge and Competence)** | | Technical Skills and Competencies | |
| **Code** | Description | Code | Description |
| **RPA** | Robotics Process Automation | IRSC | Q31. Industry regulation and standards changes. |
| **ML** | Machine Learning | AFTT | Q32. Accounting Framework Tools and Techniques. |
| **AI** | Artificial Intelligence | ITFTT | Q33. IT/ICT Frameworks, tools and techniques. |
| **Process Mining** | Process Mining | CAAT | Q37. Use of CAAT (Computed-Assisted auditing tools). |

| Composite Measures | | | | |
|---|---|---|---|---|
| **AdvancedAnalytics** | Advanced Analytics | | DCDA | Q38. Data Collection and Data Analysis |
| **Data Mining** | Data Mining | | BPA | Q39. Business Process Analysis |
| **Big Data** | Big Data | | GRCTT | Q40. Governance, risk, and control tools and techniques. |
| **Internet Of Things** | Internet of Things | | FS | Q41. Forecasting skills. |
| **Nano technology** | Nanotechnology | | CI | Q42. Identifying types of controls. |
| **Drone** | Drones | | ITASK | Q43. IT and accounting system knowledge. |
| **BlockChain** | Block Chain | | OMRS | Q44. Operational and management research skills |
| **Machine Language Processing** | Machine Language Processing | | Statistical Sampling | Q45. Statistical sampling. |
| | | | FSFA | Q46. Forensic Skills/Fraud Awareness |
| | | | Soft Skills and Competencies | |
| | | | Code | Description |
| | | | SDC | Q24. Self-motivation, determination, and confidence. |
| | | | WPDB | Q25. Ability to divide your time between work and continual professional development. |

| Composite Measures | | | |
|---|---|---|---|
| | | PISS | Q26. Problem identification and solution skills. |
| | | MAD | Q27. Meticulous attention to detail. |
| | | CS | Q28. Communication skills. |
| | | CRS | Q29. Conflict resolution/negotiation skills. |
| | | OS | Q30. Organisational Skills. |
| | | BC | Q34. Business acumen. |
| | | CMS | Q35. Change Management skills. |
| | | CTS | Q36. Critical thinking skills. |

Analysing the datasets showed that the variable representing institutions exhibited inconsistent capitalisation and abbreviations in university names, resulting in skewed descriptive data. To address this issue, the responses were rephrased to ensure consistent use of full text and capital letters for institution names in SPSS. Additionally, it was identified that some respondents did not provide answers to demographic questions. In order to include as many cases as possible in the descriptive demographic and professional data analysis, pairwise deletion was employed to handle missing data. This technique allows for the inclusion of available data points (pairs) for each specific analysis without excluding entire cases. The subsequent section will elaborate on the demographic, educational background, and professional data of the participants.

### 4.3 Attributes of Participants and Their Response Rates

There were 108 responses from all target groups, with two respondents choosing not to participate in the survey. Out of these 108 responses, only 77 (71.3%) provided

usable data that met the criteria for inclusion in the research study as detailed in table 4.3. Among the unusable responses (31 or 28.71% of the total), the reasons included participants indicating they do not work in the financial services sector and opting out of participation. Of those who responded with usable data (n=77), gender distribution was as follows: females accounted for slightly more than half at 50.6%, while males comprised an almost equal percentage at 48%. One respondent chose not to disclose their gender. Age ranges among participants were categorised into five groups: 20-29 had a majority representation at 58.4%, followed by 30-39, which accounted for 32.5%. The remaining age categories, 40-49 and 50-59, accounted for just 7% and 1%, respectively. There was no representation from the 60+ age group.

Regarding educational qualifications, bachelor's degree holders comprised a majority of 84.4%, whereas Master's degree, Diploma, and Certificate holders constituted 9.1%, 3.9% and 2.6% respectively. None of the respondents possessed a PhD level qualification. Looking at the level of experience, most respondents were experienced professionals (46.8%), trailed by professionals with Supervisor/Manager level experience and professionals newly appointed in the field for less than a year, both at 18.2%. Professionals who considered themselves to possess Specialist-level experience in their respective fields were 10.4%, and lastly, respondents with executive-level experience were 6.5%. Of the 77 respondents, 57.1% indicated that they belong to one or more Professional bodies, while 42.9% were not members of any professional body. Interestingly, only 72.7% of the respondents who belong to a professional body also reported holding a professional certification. In comparison, 6.1% of the respondents who reported not belonging to any professional body reported holding one or more certificate(s)/Designation(s) with a professional body.

*Table 4.3 Summary of Delineation Criteria*

[ Demographic characteristics(n=77)]

| Delineation criteria | Frequency statistics | |
|---|---|---|
| Gender | | |
| Female | 39 | 50.6% |
| Male | 37 | 48.1% |
| Prefer not to say | 1 | 1.3% |
| Ethnic Group | | |
| African | 3 | 3.9% |
| Black | 38 | 49.4% |
| Coloured | 11 | 14.3% |
| Indian | 11 | 14.3% |

| Delineation criteria | Frequency statistics | |
|---|---|---|
| White | 14 | 18.2% |
| Age | | |
| 20-29 | 45 | 58.4% |
| 30=39 | 25 | 32.5% |
| 40-49 | 6 | 7.8% |
| 50-59 | 1 | 1.3% |
| Highest Qualification | | |
| Master's Degree | 7 | 9.1% |
| Degree/bachelor's degree | 65 | 84.4% |
| Diploma | 3 | 3.9% |
| Certificate | 2 | 2.6% |
| Work experience | | |
| Executive | 5 | 6.5% |
| Supervisor/Manager | 14 | 18.2% |
| Specialist | 8 | 10.4% |
| Experienced | 36 | 46.8% |
| Newly appointed (less than a year) | 14 | 18.2% |
| Member of a Professional Body | | |
| Yes | 44 | 57.1% |
| No | 33 | 42.9% |
| In Possession of a Professional Certification | | |
| Yes | 34 | 44.2% |
| No | 43 | 55.58% |
| Organisational Size | | |
| 1-50 | 61 | 79.2% |
| 51-100 | 4 | 5.2% |
| 101-150 | 1 | 1.3% |
| 151-200 | 1 | 1.3% |
| >200 | 10 | 13% |
| Weekends days worked. | | |
| Yes | 6 | 7.8% |
| Sometimes | 30 | 39% |
| No | 41 | 53.2% |
| Hours worked per week. | | |
| Mean | 40.59 | |
| Median | 40 | |
| Mode | 40 | |
| Continuous Learning | | |
| Yes | 73 | 94.8% |
| No | 4 | 5.2% |

Notably, a significant proportion of the survey participants, specifically 94.8% (n=73), acknowledged the existence of upskilling opportunities within their respective organisations. This observation is meticulously documented in Table 4.3, a section dedicated to the discussion of Continuous Learning. Notably, a predominant share of

these upskilling endeavours manifests as in-house training, a phenomenon visually depicted in the accompanying graphical representation in Figure 4.1.

However, it is imperative to scrutinise the efficacy and alignment of these upskilling initiatives, particularly in relation to the cultivation of next-generation auditing skills, which include competencies in next-generation enabling technologies such as RPA, Machine Learning, Artificial Intelligence, process mining and Advanced Analytics to name a few. An extensive examination conducted by Protiviti in 2020, as articulated in the Internal Audit Capabilities and Needs Survey, underscores the pressing need for audit functions to expeditiously enhance their capacity for acquiring and nurturing the skill set requisite for next-generation auditing. The findings of this comprehensive study revealed a sobering reality, with a substantial 63% of the respondents failing to provide any discernible activities or learning opportunities conducive to fostering transformative initiatives. Even more disconcerting, an alarming 43% of the surveyed entities exhibited a lack of commitment to formulating plans to implement such transformative measures (Protiviti, 2020:1-16).

Consequently, there emerges a legitimate concern that the upskilling opportunities presently at the disposal of these respondents may not be optimally aligned with the imperative of enhancing next-generation IT audit skills and competencies.

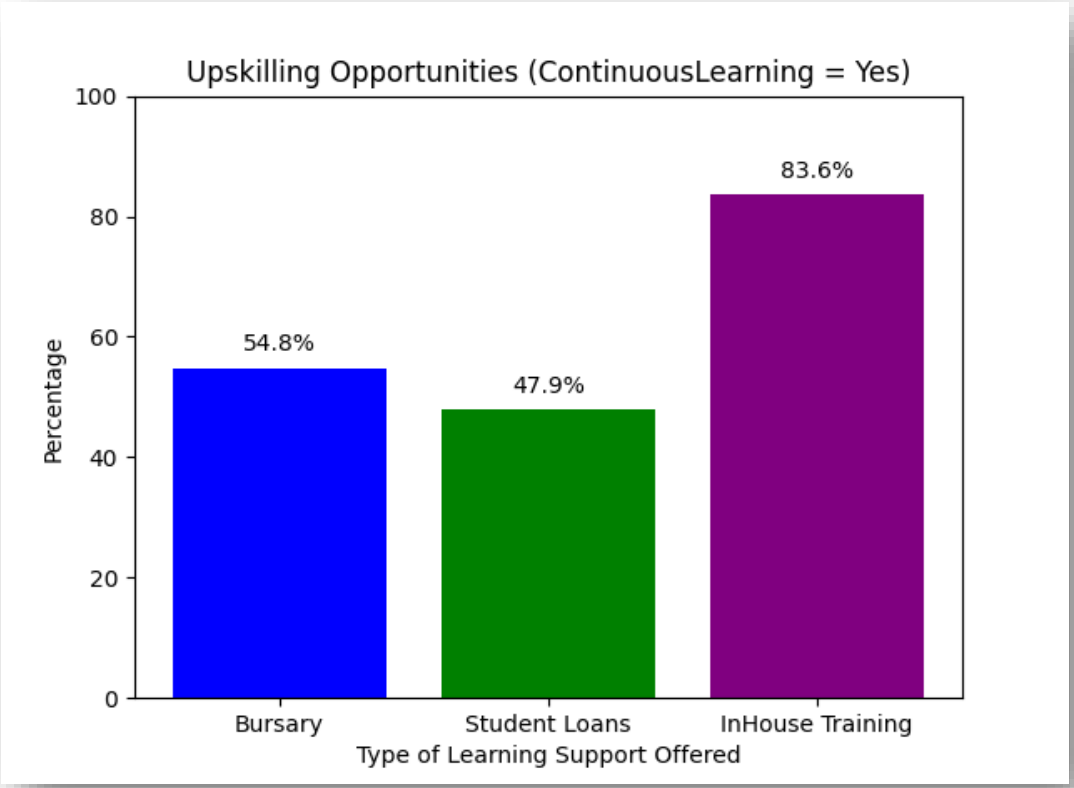



*Figure 4.1 Types of Upskilling Opportunities*

## 4.4 Correlation and Linear Regression Analysis

### 4.4.1 Inter-item Correlation Matrix

The degree to which items within the same component correlate strongly with each other while having weaker correlations with items from other components can be assessed using the inter-item correlation matrix. This helps establish convergent validity. Additionally, comparing correlations between items from different components can provide insight into discriminant validity. This discriminant validity can be used to demonstrate whether the components measure distinct constructs.

*Table 4.4 Inter-item Correlation Matrix for the level of acquired soft skills and competencies*

| Inter-Item Correlation Matrix (Soft Skills and competencies) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SDC | WPDB | PISS | MAD | CRS | OS | CS | BC | CMS | CTS |
| SDC | 1,000 | ,235 | ,357 | ,349 | ,451 | ,445 | ,430 | ,458 | ,309 | ,409 |
| WPDB | ,235 | 1,000 | ,400 | ,277 | ,261 | ,483 | ,158 | ,202 | ,199 | ,298 |
| PISS | ,357 | ,400 | 1,000 | ,446 | ,595 | ,265 | ,468 | ,392 | ,393 | ,507 |
| MAD | ,349 | ,277 | ,446 | 1,000 | ,267 | ,316 | ,531 | ,308 | ,110 | ,420 |
| CRS | ,451 | ,261 | ,595 | ,267 | 1,000 | ,407 | ,534 | ,519 | ,397 | ,544 |
| OS | ,445 | ,483 | ,265 | ,316 | ,407 | 1,000 | ,348 | ,225 | ,187 | ,329 |
| CS | ,430 | ,158 | ,468 | ,531 | ,534 | ,348 | 1,000 | ,335 | ,231 | ,518 |
| BC | ,458 | ,202 | ,392 | ,308 | ,519 | ,225 | ,335 | 1,000 | ,616 | ,568 |
| CMS | ,309 | ,199 | ,393 | ,110 | ,397 | ,187 | ,231 | ,616 | 1,000 | ,522 |
| CTS | ,409 | ,298 | ,507 | ,420 | ,544 | ,329 | ,518 | ,568 | ,522 | 1,000 |

The inter-item correlation between the soft skills and competencies component variables shows a positive correlation. Further, we can see that these variables generally tend to move together in a similar direction. Looking at the SDC variable and how it correlates with the other variables within this component, we can observe that the correlation between the WPDB and the CMS (r= .235 and .309) variables generally indicates a weaker positive correlation. This suggests that there is a connection between these variables. However, this relationship might not be as strong when compared to the other variables within the component. The other variables (PISS, MAD, CRS, OS, CS, BC, CMS, CTC) indicate a positive moderate relationship with the SDC variable.

For the WPDB variable, based on the table indicate that most of the relationship with the variables within this component, although positive, are weaker except when compared to the connection with the PISS and the OS variable that indicated a positive Moderate connection at (r= .400 and .483) respectively. The PISS variable indicates a moderately strong relationship between most of the variables and a somewhat moderate-high positive relationship with the CRS variable at r= .595, whereas the relationship between the OS variable indicates a weaker positive relationship. The MAD variable has a weaker positive relationship with the variables within this component, as indicated by r ranging from (r= .110 to r= .316). However, the connection indicates a moderate positive relationship of (r= .349, .446, .531 and .420). for the SDC, PISS, CS and CTS variables, respectively. There was one instance

where CRS indicated to have a moderate correlation with the PISS variable at r= .595, with six of the other variables within this component indicating a moderate connection to the CRS variable from r= .397 to r = .544. with only two variables (SDC and MAD) noted to have a weaker correlation with the CRS variable.

The OS variable predominately indicated a weaker positive correlation between the other variables within this component, ranging from r= .158 to r= .329 for 5 of the nine variables, as highlighted in red. The connection indicated a positive moderate relationship for the remainder of the four variables. The opposite is noted for the CS variable, where most of the correlation is leaning towards a generally positive moderate correlation with only three variables, WPDB, BC, and CMS, indicating a weaker positive connection with the CS variable within this component. The BC variable is observed as the only variable within this component to indicate a moderate-high correlation between the two variables, as could be noted between the correlation with the CMS (r=.616) and CTS (r=.568) variables. There were also some variables where this connection was noted to indicate a weaker positive relationship where BC-WPDB is r= .202, BC – OS is r= .225, BC- MAD is r= .308, and BC- CS is r=.308.

The rest of the correction with the other variables within this correction indicated moderate positive connection as indicated by BC- SDC at r= .458, BC- PISS at r= .392, and BC- CRS at r= 519. The CMS variable showed predominately weaker positive connection indicators between the other variables in this component, followed by a moderate correlation between CMS – PISS (r= .393), CMS- CRS (r= .397), and CMS- CTC (r=.522). There is also a moderate-positive correlation between the two variables in this component, as indicated by CMC – BC (r= .616). Lastly, the Correlation between the CTC variable and the other variable within this component indicates a predominately moderate correlation, with the correlation between CTC-BC leaning towards a moderate to high connection and CTS-OS and CTS-WPDB correlations slightly skewed to a weaker positive correlation. In conclusion, the correlation between the variables within this component indicates a positive moderate relationship between the variables, with some strong areas where the connection is weaker albeit still positive.

*Table 4.5 Inter-item correlation Matrix for acquired Technical Skills and Competencies*

| Inter-Item Correlation Matrix (Technical Skills and Competencies) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IRSC | AFTT | ITFTT | CAAT | DCDA | BPA | GRCTT | FS | CI | ITASK | OMRS | Statistical sampling | FSFA |
| IRSC | 1,000 | ,546 | ,598 | ,541 | ,499 | ,523 | ,598 | ,389 | ,625 | ,515 | ,539 | ,495 | ,518 |
| AFTT | ,546 | 1,000 | ,539 | ,559 | ,457 | ,425 | ,428 | ,438 | ,506 | ,557 | ,482 | ,478 | ,436 |
| ITFTT | ,598 | ,539 | 1,000 | ,502 | ,569 | ,426 | ,608 | ,385 | ,599 | ,547 | ,535 | ,474 | ,444 |
| CAAT | ,541 | ,559 | ,502 | 1,000 | ,686 | ,564 | ,387 | ,484 | ,472 | ,614 | ,355 | ,431 | ,403 |
| DCDA | ,499 | ,457 | ,569 | ,686 | 1,000 | ,697 | ,528 | ,521 | ,384 | ,490 | ,399 | ,584 | ,422 |
| BPA | ,523 | ,425 | ,426 | ,564 | ,697 | 1,000 | ,633 | ,436 | ,562 | ,485 | ,395 | ,439 | ,439 |
| GRCTT | ,598 | ,428 | ,608 | ,387 | ,528 | ,633 | 1,000 | ,299 | ,677 | ,516 | ,479 | ,408 | ,462 |
| FS | ,389 | ,438 | ,385 | ,484 | ,521 | ,436 | ,299 | 1,000 | ,287 | ,294 | ,525 | ,583 | ,472 |
| CI | ,625 | ,506 | ,599 | ,472 | ,384 | ,562 | ,677 | ,287 | 1,000 | ,691 | ,597 | ,417 | ,597 |
| ITASK | ,515 | ,557 | ,547 | ,614 | ,490 | ,485 | ,516 | ,294 | ,691 | 1,000 | ,606 | ,407 | ,617 |
| OMRS | ,539 | ,482 | ,535 | ,355 | ,399 | ,395 | ,479 | ,525 | ,597 | ,606 | 1,000 | ,528 | ,631 |
| Statistical sampling | ,495 | ,478 | ,474 | ,431 | ,584 | ,439 | ,408 | ,583 | ,417 | ,407 | ,528 | 1,000 | ,638 |
| FSFA | ,518 | ,436 | ,444 | ,403 | ,422 | ,439 | ,462 | ,472 | ,597 | ,617 | ,631 | ,638 | 1,000 |

The correlations between the variables within the technical skills and competencies component demonstrated an overall positive relationship. Looking at how each variable positively correlates with the other variables within this component, a closer analysis indicated that for the IRSC variable, there is a predominately moderate correlation with a few relationships (ITFTT= .598, GRCTT= .598, and CI = .625) demonstrating moderately strong relationships with the other variables. The same trend is indicated with the other variables, but some, such as the FS-CI and FC-ITASK, had a somewhat weaker correlation compared to the others. The CI variable has a strong relationship with most of the other variables within the component except for the correlation with the FS variable, which indicates that the CI variables tend to be more closely related to the other variables when measuring IT auditors' technical skills and competencies.

*Table 4.6 Inter-item correlation Matrix for the level of Acquired IT Audit Skills and Competencies*

| Inter-Item Correlation Matrix (ITAuditSC) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SDC | WPDB | PISS | MAD | CS | CRS | OS | BC | CMS | CTS | IRSC | AFTT | ITFTT | CAAT | DCDA | BPA | GRCTT | FS | CI | ITASK | OMRS | Statistical sampling | FSFA |
| SDC | 1,000 | ,235 | ,357 | ,349 | ,430 | ,451 | ,445 | ,458 | ,309 | ,409 | ,349 | ,208 | ,289 | ,141 | ,278 | ,234 | ,416 | ,297 | ,265 | ,215 | ,317 | ,114 | ,216 |
| WPDB | ,235 | 1,000 | ,400 | ,277 | ,158 | ,261 | ,483 | ,202 | ,199 | ,298 | ,196 | ,085 | ,274 | ,133 | ,212 | ,216 | ,296 | ,077 | ,116 | -,037 | ,117 | ,067 | ,001 |
| PISS | ,357 | ,400 | 1,000 | ,446 | ,468 | ,595 | ,265 | ,392 | ,393 | ,507 | ,460 | ,337 | ,534 | ,524 | ,527 | ,428 | ,531 | ,252 | ,474 | ,475 | ,394 | ,376 | ,381 |
| MAD | ,349 | ,277 | ,446 | 1,000 | ,531 | ,267 | ,316 | ,308 | ,110 | ,420 | ,241 | ,192 | ,238 | ,284 | ,233 | ,140 | ,150 | ,109 | ,261 | ,215 | ,207 | ,084 | ,007 |
| CS | ,430 | ,158 | ,468 | ,531 | 1,000 | ,534 | ,348 | ,335 | ,231 | ,518 | ,305 | ,224 | ,251 | ,188 | ,228 | ,214 | ,265 | ,267 | ,420 | ,387 | ,378 | ,119 | ,197 |
| CRS | ,451 | ,261 | ,595 | ,267 | ,534 | 1,000 | ,407 | ,519 | ,397 | ,544 | ,526 | ,359 | ,500 | ,377 | ,374 | ,413 | ,395 | ,374 | ,550 | ,454 | ,489 | ,273 | ,495 |
| OS | ,445 | ,483 | ,265 | ,316 | ,348 | ,407 | 1,000 | ,225 | ,187 | ,329 | ,316 | ,056 | ,208 | ,060 | ,058 | ,091 | ,306 | ,096 | ,243 | ,119 | ,159 | -,128 | ,083 |
| BC | ,458 | ,202 | ,392 | ,308 | ,335 | ,519 | ,225 | 1,000 | ,616 | ,568 | ,566 | ,469 | ,422 | ,399 | ,435 | ,613 | ,558 | ,332 | ,554 | ,429 | ,482 | ,403 | ,468 |
| CMS | ,309 | ,199 | ,393 | ,110 | ,231 | ,397 | ,187 | ,616 | 1,000 | ,522 | ,472 | ,536 | ,545 | ,307 | ,405 | ,508 | ,515 | ,417 | ,571 | ,378 | ,569 | ,550 | ,471 |
| CTS | ,409 | ,298 | ,507 | ,420 | ,518 | ,544 | ,329 | ,568 | ,522 | 1,000 | ,517 | ,439 | ,514 | ,394 | ,473 | ,401 | ,392 | ,362 | ,498 | ,422 | ,459 | ,455 | ,433 |
| IRSC | ,349 | ,196 | ,460 | ,241 | ,305 | ,526 | ,316 | ,566 | ,472 | ,517 | 1,000 | ,546 | ,598 | ,541 | ,499 | ,523 | ,598 | ,389 | ,625 | ,515 | ,539 | ,495 | ,518 |
| AFTT | ,208 | ,085 | ,337 | ,192 | ,224 | ,359 | ,056 | ,469 | ,536 | ,439 | ,546 | 1,000 | ,539 | ,559 | ,457 | ,425 | ,428 | ,438 | ,506 | ,557 | ,482 | ,478 | ,436 |
| ITFTT | ,289 | ,274 | ,534 | ,238 | ,251 | ,500 | ,208 | ,422 | ,545 | ,514 | ,598 | ,539 | 1,000 | ,502 | ,569 | ,426 | ,608 | ,385 | ,599 | ,547 | ,535 | ,474 | ,444 |
| CAAT | ,141 | ,133 | ,524 | ,284 | ,188 | ,377 | ,060 | ,399 | ,307 | ,394 | ,541 | ,559 | ,502 | 1,000 | ,686 | ,564 | ,387 | ,484 | ,472 | ,614 | ,355 | ,431 | ,403 |
| DCDA | ,278 | ,212 | ,527 | ,233 | ,228 | ,374 | ,058 | ,435 | ,405 | ,473 | ,499 | ,457 | ,569 | ,686 | 1,000 | ,697 | ,528 | ,521 | ,384 | ,490 | ,399 | ,584 | ,422 |
| BPA | ,234 | ,216 | ,428 | ,140 | ,214 | ,413 | ,091 | ,613 | ,508 | ,401 | ,523 | ,425 | ,426 | ,564 | ,697 | 1,000 | ,633 | ,436 | ,562 | ,485 | ,395 | ,439 | ,439 |
| GRCTT | ,416 | ,296 | ,531 | ,150 | ,265 | ,395 | ,306 | ,558 | ,515 | ,392 | ,598 | ,428 | ,608 | ,387 | ,528 | ,633 | 1,000 | ,299 | ,677 | ,516 | ,479 | ,408 | ,462 |
| FS | ,297 | ,077 | ,252 | ,109 | ,267 | ,374 | ,096 | ,332 | ,417 | ,362 | ,389 | ,438 | ,385 | ,484 | ,521 | ,436 | ,299 | 1,000 | ,287 | ,294 | ,525 | ,583 | ,472 |
| CI | ,265 | ,116 | ,474 | ,261 | ,420 | ,550 | ,243 | ,554 | ,571 | ,498 | ,625 | ,506 | ,599 | ,472 | ,384 | ,562 | ,677 | ,287 | 1,000 | ,691 | ,597 | ,417 | ,597 |
| ITASK | ,215 | -,037 | ,475 | ,215 | ,387 | ,454 | ,119 | ,429 | ,378 | ,422 | ,515 | ,557 | ,547 | ,614 | ,490 | ,485 | ,516 | ,294 | ,691 | 1,000 | ,606 | ,407 | ,617 |
| OMRS | ,317 | ,117 | ,394 | ,207 | ,378 | ,489 | ,159 | ,482 | ,569 | ,459 | ,539 | ,482 | ,535 | ,355 | ,399 | ,395 | ,479 | ,525 | ,597 | ,606 | 1,000 | ,528 | ,631 |
| Statistical sampling | ,114 | ,067 | ,376 | ,084 | ,119 | ,273 | -,128 | ,403 | ,550 | ,455 | ,495 | ,478 | ,474 | ,431 | ,584 | ,439 | ,408 | ,583 | ,417 | ,407 | ,528 | 1,000 | ,638 |
| FSFA | ,216 | ,001 | ,381 | ,007 | ,197 | ,495 | ,083 | ,468 | ,471 | ,433 | ,518 | ,436 | ,444 | ,403 | ,422 | ,439 | ,462 | ,472 | ,597 | ,617 | ,631 | ,638 | 1,000 |

The majority of variables assessing the proficiency of IT internal audit skills and competencies in Table 4.6 above exhibit a consistent and positive co-variation. This implies that when one of these variables increases, the others tend to increase in tandem. However, a noteworthy pattern emerges when we delve into soft skills and competencies among IT internal auditors. While the relationship within this category remains positive, it is not as robust as observed in the domain of IT technical skills and competencies. Except for the CTS, CRS and PISS variables, these unsurprisingly demonstrated a predominately robust relationship within this component. It is worth noting that the reason these variables presented higher correlations despite their counterparts is demonstrated in the cruciality of these soft skills and competencies to the IT audit profession. These soft skills and competencies enable IT audit

professionals to analyse complex systems, processes and data and evaluate the information provided to identify patterns and make sound judgments. They also provide IT audit professionals with the ability to identify issues and problems within an organisation's IT systems and processes and propose effective solutions. They further enable the expertise to encounter and handle resistance or conflicts when conducting audits or recommending changes, which can be vital for navigating these situations diplomatically, resolving disputes, and maintaining productive working relationships with colleagues and stakeholders.

A concerning Observation is with the CS variable measuring the proficiency of IT audit professionals' abilities to adequately communicate with the auditees and other stakeholders, demonstrating a less robust relationship with most of the variables within this component. This is concerning because effective written and verbal communication is crucial for conveying audit findings and recommendations clearly and persuasively within the IT audit profession. Harrington (2016) concurs with this statement and clearly states the need for IT audit professionals to be good communicators when it comes to delivering tough messages to an auditee in a productive and constructive manner. Bizarro emphasised that IT audit professionals must be strong professionals (Bizarro, 2019). This skill is also rated as one of the top 10 core competencies of an Internal Auditor by the IIA Global Competency Framework (IIA Global Competency Framework, 2013). However, we can take comfort in the fact that this was not the case with SDC (self-motivation, determination and confidence), PISS, MAD (Meticulous intention to detail), CRS, CTS, CI (Identifying types of controls), ITASK (It and accounting system knowledge), OMRS (Operational and management research skills). This means that although this correlation was not as robust with other variables, there were supporting variables supporting an increase in this crucial skill and competence.

The other particular observation of interest pertains to the WPDB variable, signifying the ability to effectively manage one's time between work responsibilities and continuous professional development. Its relationship with the FSFA variable, denoting Forensic Skills and Fraud Awareness, stands out due to its remarkable weakness, indicated by an extremely low correlation coefficient (r= .001). Essentially, this suggests that there is virtually no discernible connection between an IT auditor's

capacity to balance their time between job commitments and self-improvement endeavours and their competence regarding fraud awareness or forensic audit. In simpler terms, being adept at time management for professional development does not appear to influence an individual's proficiency in fraud awareness or forensic auditing.

A similar conclusion emerges when considering the correlation between the FSFA variable and the MAD (Meticulous Attention to Detail) variable, with a meagre correlation coefficient of .007. This finding aligns with the premise that there is no substantive relationship between an IT auditor's meticulous attention to detail and their ability to perform forensic audits or engage in fraud awareness campaigns. In essence, these variables appear to measure distinct and unrelated aspects of an IT auditor's skill set.

Furthermore, the relationship between ITASK (IT and Accounting System Knowledge) and WPDB is noteworthy due to its negative correlation of -.037. This suggests that, to some extent, an inverse relationship exists between an IT auditor's knowledge of IT and accounting systems and their ability to manage time effectively for continuous professional development. In simpler terms, an increase in IT and accounting system knowledge may correspond to a decrease in the capacity to balance professional development with work commitments. Similarly, the statistical sampling skills (statistical sampling) variable and communication skills (CS) variable exhibit a negative correlation of -.128. While this relationship is weaker than the predominantly positive relationships, it implies that as an individual's statistical sampling skills improve, their communication skills may decrease, and vice versa. This intriguing finding may warrant further exploration with a larger dataset to ascertain its significance and implications more conclusively.

It becomes conceivable to draw an inference from the relatively modest correlation exhibited by the WPDB variable. This correlation analysis suggests that, despite the provision of upskilling opportunities within IT audit departments, a noteworthy imbalance exists in the allocation of time resources between fulfilling IT Audit engagements and facilitating continuous professional development. This imbalance raises concerns about the extent to which IT audit professionals can sustain the

alignment of their skills and competency levels with the demands of next-generation audit environments.

In summary, the analysis underscores the distinctiveness of the variables in question and supports the notion that they measure separate facets of an IT auditor's skill set. The absence of significant correlations between certain variables implies that expertise in one area does not necessarily translate to proficiency in another, emphasising the multifaceted nature of IT internal audit skills and competencies.

*Table 4.7 Inter-item correlation Matrix for the Technological Adoption on an Organisational level*

| Inter-Item Correlation Matrix (LOAO) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RPA2 | ML2 | AI2 | Process Mining2 | Advanced Analytics 2 | Data Mining2 | Big Data2 | Internet of Things 2 | Nano technology 2 | Drones 2 | Blockchain2 | Machine Language processing2 |
| RPA2 | 1,000 | ,553 | ,457 | ,639 | ,476 | ,610 | ,544 | ,512 | ,300 | ,269 | ,349 | ,500 |
| ML2 | ,553 | 1,000 | ,710 | ,631 | ,538 | ,514 | ,654 | ,578 | ,383 | ,389 | ,385 | ,695 |
| AI2 | ,457 | ,710 | 1,000 | ,644 | ,564 | ,540 | ,559 | ,558 | ,299 | ,211 | ,156 | ,489 |
| ProcessMining2 | ,639 | ,631 | ,644 | 1,000 | ,567 | ,675 | ,569 | ,584 | ,439 | ,318 | ,394 | ,612 |
| AdvancedAnalytics2 | ,476 | ,538 | ,564 | ,567 | 1,000 | ,628 | ,591 | ,373 | ,136 | ,240 | ,309 | ,470 |
| DataMining2 | ,610 | ,514 | ,540 | ,675 | ,628 | 1,000 | ,691 | ,601 | ,349 | ,234 | ,393 | ,603 |
| BigData2 | ,544 | ,654 | ,559 | ,569 | ,591 | ,691 | 1,000 | ,657 | ,309 | ,222 | ,324 | ,605 |
| InternetofThings2 | ,512 | ,578 | ,558 | ,584 | ,373 | ,601 | ,657 | 1,000 | ,434 | ,269 | ,394 | ,561 |
| Nanotechnology2 | ,300 | ,383 | ,299 | ,439 | ,136 | ,349 | ,309 | ,434 | 1,000 | ,482 | ,522 | ,393 |
| Drones2 | ,269 | ,389 | ,211 | ,318 | ,240 | ,234 | ,222 | ,269 | ,482 | 1,000 | ,396 | ,413 |
| Blockchain2 | ,349 | ,385 | ,156 | ,394 | ,309 | ,393 | ,324 | ,394 | ,522 | ,396 | 1,000 | ,456 |
| MachineLanguageprocessing2 | ,500 | ,695 | ,489 | ,612 | ,470 | ,603 | ,605 | ,561 | ,393 | ,413 | ,456 | 1,000 |

Table 4.7 demonstrates the adoption levels of each technology within an organisation in the financial services sector where all the technologies show positive correlations with each other within the component, with a higher indication that as one technology is being adopted, the strength of the other technologies to also have a high adoption is elevated. This is a common trend of association with all the technologies except Drones, Nanotechnology, and Blockchain.

The association between Nanotechnology, Drones and Blockchain adoption levels with the other technologies demonstrated a predominately Moderately weak positive relationship with correlation coefficients of up to r=.522. However, RPA's association with Process Mining and Data mining demonstrated stronger positive correlations at r= .639 and .610, respectively. Blockchain's association with AI and Advanced

Analytics demonstrated a weaker positive correlation of r =.156 and .309, respectively. Same as Nanotechnology's association with the Advanced Analytics, AI and Big Data variables with r=.136, .299 and .309, suggesting a less pronounced relationship between these variables or other factors might influence their adoption independently.

The association between the Drones variable and the other variables within this component exhibit predominately weaker positive relationships, with a few exceptions on the association with ML, Nanotechnology, Blockchain, and Machine Learning processing variables where this relationship is relatively moderately positive—suggesting a largely less pronounced relationship between the adoption of Drones within each AI department with other technologies, or other factors influencing the adoption of Drones within AI departments independently. What is worth also noting is the relationship between RPA and drones, which demonstrated a relatively weak connection between these variables. This observation holds particular significance as it aligns with the findings of a 2019 study. In that study, 64% of the Chief Audit Executives (CAEs) surveyed reported that their organisations were confronting disruptions or innovations in RPA, while 18% of respondents indicated that their organisations were engaging in innovation related to Drone technology (Christ et al., 2019).

*Table 4.8 Inter-item correlation Matrix for the Technological Adoption on a Departmental Level.*

| Inter-Item Correlation Matrix (LOAD) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RPA3 | ML3 | AI3 | Process Mining3 | Advanced Analytics3 | DataMining3 | BigData3 | Internetof Things3 | Nanotechnology3 | Drones3 | Blockchain3 | Machine Language Processing 3 |
| RPA3 | 1,000 | ,598 | ,636 | ,622 | ,470 | ,451 | ,456 | ,451 | ,243 | ,173 | ,313 | ,560 |
| ML3 | ,598 | 1,000 | ,782 | ,697 | ,436 | ,465 | ,624 | ,614 | ,508 | ,465 | ,479 | ,743 |
| AI3 | ,636 | ,782 | 1,000 | ,656 | ,553 | ,591 | ,583 | ,614 | ,459 | ,350 | ,491 | ,631 |
| ProcessMining3 | ,622 | ,697 | ,656 | 1,000 | ,498 | ,626 | ,533 | ,582 | ,538 | ,432 | ,467 | ,655 |
| AdvancedAnalytics3 | ,470 | ,436 | ,553 | ,498 | 1,000 | ,707 | ,667 | ,382 | ,150 | ,240 | ,468 | ,457 |
| DataMining3 | ,451 | ,465 | ,591 | ,626 | ,707 | 1,000 | ,688 | ,459 | ,349 | ,217 | ,537 | ,586 |
| BigData3 | ,456 | ,624 | ,583 | ,533 | ,667 | ,688 | 1,000 | ,520 | ,385 | ,302 | ,556 | ,653 |
| InternetofThings3 | ,451 | ,614 | ,614 | ,582 | ,382 | ,459 | ,520 | 1,000 | ,505 | ,394 | ,607 | ,539 |
| Nanotechnology3 | ,243 | ,508 | ,459 | ,538 | ,150 | ,349 | ,385 | ,505 | 1,000 | ,647 | ,592 | ,485 |
| Drones3 | ,173 | ,465 | ,350 | ,432 | ,240 | ,217 | ,302 | ,394 | ,647 | 1,000 | ,531 | ,344 |
| Blockchain3 | ,313 | ,479 | ,491 | ,467 | ,468 | ,537 | ,556 | ,607 | ,592 | ,531 | 1,000 | ,506 |
| Machine Language Processing3 | ,560 | ,743 | ,631 | ,655 | ,457 | ,586 | ,653 | ,539 | ,485 | ,344 | ,506 | 1,000 |

The LOAD component in Table 4.4 looks at the level of adoption of each advanced technology within an organisation in the financial services sector. Table 4.9 demonstrates a positive relationship between each variable within this component. This suggests that higher adoption of one technology is associated with higher adoption of the other. The magnitude of this correlation for the AI variable with the other variables within this component suggests a stronger relationship indicative of a robust connection between these technologies' adoption levels. However, the correlation between the same variable with the Drones, Nanotechnology, Blockchain, and Advanced Analytics variables suggests that while there is a positive relationship, it is moderately strong compared to the other variables within the same component. At the same time, the relationship of the Blockchain variable has a predominately moderate-strong level of association with the other variables, with the association with data, Internet of Things and Nanotechnology variables leaning towards a strong association with the Blockchain variable. This is the opposite for the Drones variable, where the strength of the correlation demonstrates a moderately weak relationship.

Furthermore, RPA and drone variables demonstrate the weakest connection with each other at r= .173. This was the same between the RPA – Nanotechnology at r= .243, Advanced Analytics – Nanotechnology at r= .150, Advanced Analytics- Drones at r= .240, Datamining- Drones at r= .217, and Datamining- Nanotechnology at r= .349. Notedly, Advanced Analytics- Nanotechnology exhibited the weakest connection of all the variables within this component. In summary, these correlations suggest that the adoption levels of various technologies within this component are related to each other to varying degrees. Using this data and further analysis, assumptions can be made about the influence these may have contributed or may have been attributable to the level of knowledge and experience the dependents would have with these technologies by identifying areas where synergies or dependencies exist among these technologies.

*Table 4.9 Inter-item Correlation Matrix for the Level of Knowledge and Expertise in the use of the Technology.*

| Inter-Item Correlation Matrix (LOKSC) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RPA | ML | AI | ProcessMining | Advanced Analytics | DataMining | Blockchain | Machinelanguageprocessing | BigData | Drones | Nanotechnology | InternetofThings |
| RPA | 1,000 | ,380 | ,335 | ,373 | ,398 | ,358 | ,271 | ,312 | ,274 | ,053 | ,019 | ,181 |
| ML | ,380 | 1,000 | ,797 | ,545 | ,360 | ,588 | ,558 | ,752 | ,595 | ,592 | ,345 | ,578 |
| AI | ,335 | ,797 | 1,000 | ,304 | ,397 | ,448 | ,619 | ,711 | ,603 | ,550 | ,293 | ,625 |
| ProcessMining | ,373 | ,545 | ,304 | 1,000 | ,321 | ,685 | ,365 | ,477 | ,438 | ,423 | ,467 | ,327 |
| AdvancedAnalytics | ,398 | ,360 | ,397 | ,321 | 1,000 | ,501 | ,568 | ,457 | ,546 | ,365 | ,224 | ,396 |
| DataMining | ,358 | ,588 | ,448 | ,685 | ,501 | 1,000 | ,621 | ,598 | ,624 | ,520 | ,444 | ,481 |
| Blockchain | ,271 | ,558 | ,619 | ,365 | ,568 | ,621 | 1,000 | ,705 | ,563 | ,495 | ,387 | ,387 |
| Machinelanguageprocessing | ,312 | ,752 | ,711 | ,477 | ,457 | ,598 | ,705 | 1,000 | ,672 | ,529 | ,475 | ,645 |
| BigData | ,274 | ,595 | ,603 | ,438 | ,546 | ,624 | ,563 | ,672 | 1,000 | ,457 | ,324 | ,482 |
| Drones | ,053 | ,592 | ,550 | ,423 | ,365 | ,520 | ,495 | ,529 | ,457 | 1,000 | ,445 | ,569 |
| Nanotechnology | ,019 | ,345 | ,293 | ,467 | ,224 | ,444 | ,387 | ,475 | ,324 | ,445 | 1,000 | ,292 |
| InternetofThings | ,181 | ,578 | ,625 | ,327 | ,396 | ,481 | ,387 | ,645 | ,482 | ,569 | ,292 | 1,000 |

Last on the inter-item correlation analysis is demonstrated by Table 4.11 and looks at the level of knowledge and expertise in using the identified technologies by the respondents. All the variables within this component exhibit a positive relationship between each other. Suggesting that individuals with higher knowledge and expertise in one technology are more likely to have higher knowledge and expertise in other technologies. The magnitude of the association between most of these variables is leaning slightly towards a stronger positive relationships where r>=.558. Indicating a robust connection between the level of knowledge and expertise in these technologies. However, there is also a moderate connection in the relationship between a substantial amount of the variables within this component where r>.350<.558. Suggesting that having knowledge and expertise in one technology is less strongly associated with having knowledge and expertise in another. It is worth highlighting that the correlation analysis conducted among Robotics Process Automation (RPA), Machine Learning (ML), Process Mining, advanced Analytics, and Artificial Intelligence (AI) reveals a moderate relationship among these key elements.

This observation holds significance in light of the 2020 study by Protiviti, which indicated that the competency levels of Internal Audit departments in these enabling technologies were, at best, moderate. Importantly, this moderation was consistent across these technologies, as indicated by respondents who exhibited similar levels of competency in each (Protiviti, 2020:11).

However, the current correlation analysis offers new insights, suggesting that possessing knowledge and expertise in one technology is less strongly associated with possessing knowledge and expertise in the others. This implies a potentially evolving landscape in which proficiency in each of these technological domains may have not shown any improvements while on some it has become increasingly distinct and specialised, marking a departure from the previously observed consistency. In light of these findings, Charmian Simmons (a subject matter expect at Thomson Reuters) emphasised the significance of Internal auditors acquiring knowledge in these technologies for effective auditing purposes (Simmons & Anunciacion:2018).

There is also a few relationships within these variables where the correlation is quite weak with r<.350>.150, indicating that there isn't a strong relationship between the knowledge and expertise between those variables. Meaning, being knowledgeable and having experience in one doesn't necessarily imply knowledge and expertise in the other. And there are a few correlations where the relationship is very weak with r=<.150, suggesting that knowledge and expertise between the technologies are almost independent of each other, meaning there is little to no relationship between those two areas of expertise. In summary, there is some degree of alignment between these technologies. However, the strength of these relationships varies, with stronger associations for ML, AI, Datamining, Blockchain, Machine Language processing, Big-Data and Internet of Things. And weaker associations for RPA, and Nanotechnology and the rest exhibiting moderate-weak association.

### 4.4.2 Tabulation between variables of interest

The research makes assumptions that there is misalignment between the skills and competencies that IT auditors have in relation to the skills and competencies that they will require in a technologically advanced environment. Therefore, the relationship that might exist between the ordinal data that measures the acquired skills and competencies of IT Internal Auditors and the Usage and experience of the different identified Technological advances by IT Auditors would be expected to be positively correlated. Whereas the relationship between Acquired Soft skills and competencies and technical skills and competencies does not necessarily have to be associated nor is it expected that they be independent of each other. To measure this association or the independence of these components were utilised the Chi-Square test as

documented in tables 10.1 shows the Linear -by-linear Kendall's Tau-b correlation used to quantify and examine the strength and direction of the relationships between the ordinal independent variables (Denis, 2020).

*Table 4.10 Tabulation Measures between Variables of Interest*

**Association between Soft Skills and Competencies * LOKSCT**

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Linear-by-Linear Association | 12,790 | 1 | <.001 |
| N of Valid Cases | 77 | | |

**Symmetric Measures[d]**

| | | Value | Asymptotic Standard Error[a] | Approximate T[b] | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Kendall's tau-b | ,263 | ,075 | 3,494 | <.001 |
| | Spearman Correlation | ,369 | ,100 | 3,440 | <.001[c] |
| N of Valid Cases | | 77 | | | |

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

**Association between Technical Skills and Competencies * LOKSC**

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Linear-by-Linear Association | 12,487 | 1 | <.001 |
| N of Valid Cases | 77 | | |

**Symmetric Measures[d]**

| | | Value | Asymptotic Standard Error[a] | Approximate T[b] | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Kendall's tau-b | ,280 | ,065 | 4,283 | <.001 |
| | Spearman Correlation | ,408 | ,091 | 3,871 | <.001[c] |
| N of Valid Cases | | 77 | | | |

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

### 4.4.3 Linear Regression Analysis

*Table 4.11 Linear Regression Between LOKSCT and LOAO*

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | ,502[a] | ,252 | ,242 | ,78536 | ,252 | 25,304 | 1 | 75 | <.001 |
| a. Predictors: (Constant), LOKSCT | | | | | | | | | |
| b. Dependent Variable: LOAO | | | | | | | | | |

Table 4.11 shows that the correlation coefficient (R) of .502 indicates a moderate positive linear relationship between the independent construct LOKSCT and the dependent construct LOAO. The regression model, with an R square (coefficient of determination) value of .252, suggests that approximately 25.2% of variability in LOAO can be explained by the variability in LOKSCT. The adjusted R square is .242, which takes into account the number of predictors to provide a more accurate estimate for explaining variance. The standard error of estimate measures at .78536 represents average distance between observed data points and predicted values from regression model. With an F change value at 25,304 indicating goodness-of-fit for this well-fitting model and significance level <0.001 demonstrating statistically significant improvement after incorporating LOKSCT as predictor variable significantly enhancing ability to predict LOAO.

This holds significant implications as it suggests a statistically significant relationship between the level of knowledge and expertise in technology enablers of a next-generation Audit environment and the adoption of such technology in these Audit environments. The 25.2% variability explained indicates that a substantial portion of the variation in Technology adoption can be attributed to the skills and competencies of IT Audit professionals in this area. This underscores the importance of assessing and potentially enhancing the proficiency of IT audit professionals in these technologies. ANOVA results further reinforce this idea shown graphically as Figure 4.2 below:

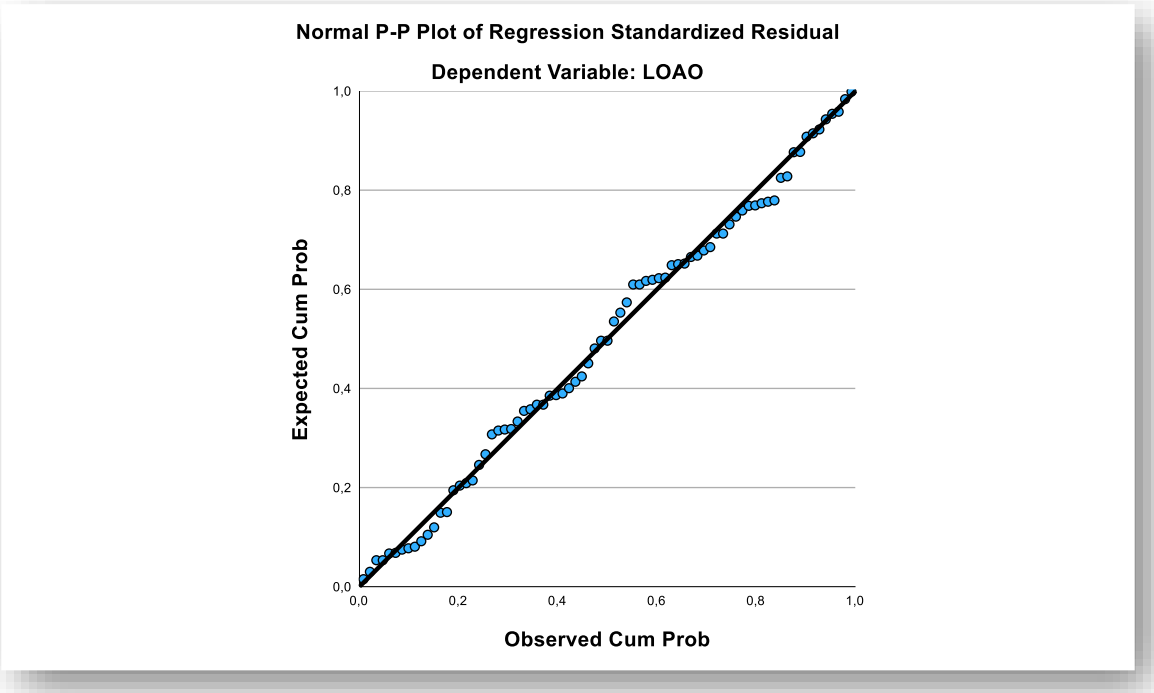



*Figure 4.2 ANOVA Normal P-P Plot of Regression Standardized Residual - Dependent Variable (LOAO)*

In summary, the regression analysis provides evidence that LOKSCT is a statistically significant predictor of LOAO, and the correlation and R Square values suggests a meaningful relationship between the two constructs. This strengthens the understanding of the relationship and predictive value of LOKSCT and LOAO and suggests that a substantial portion of the variance in technology adoption may be influenced by the competencies of IT audit professionals, making it a pertinent area of focus for addressing any misalignment between current skills and competencies and the skills and competencies required for next-generation auditing environments.

*Table 4.12 ANOVA*

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | **Regression** | 14,595 | 1 | 14,595 | 19,509 | <.001[b] |
| | **Residual** | 56,109 | 75 | ,748 | | |
| | **Total** | 70,704 | 76 | | | |
| a. Dependent Variable: LOAD | | | | | | |
| b. Predictors: (Constant), LOKSCT | | | | | | |

The presented results of table 4.12 stem from an analysis of variance (ANOVA) conducted within the context of a regression model. In this analysis, the dependent variable under scrutiny is LOAD, representing an aggregated value of the variables within the LOAD component measuring the adoption levels of the selected technologies within an IT audit department. In contrast, the independent variable or predictor is denoted as LOKSCT, representing an aggregated value for the level of knowledge and expertise in the use of the selected technologies. Starting with the Regression Sum of Squares (SS), the regression model successfully accounts for 14,595 units of variability within the LOAD variable. This statistic signifies the extent to which the model elucidates and clarifies the observed variations in LOAD.

The allocation of Degrees of Freedom (df) delineates the separation of degrees of freedom for distinct components within the analysis. For the component related to regression, precisely one degree of freedom is attributed, corresponding to the LOKSCT predictor. Conversely, the Residual (Error) component is assigned 75 degrees of freedom, signifying the unexplained variability present within the dataset. The combined degrees of freedom for both regression and error yield 76 degrees of freedom.

Mean Square (MS) measures the variance explained per degree of freedom within each component. Specifically, the mean square stands at 14,595 for the regression aspect, indicating the proportion of variance in LOAD that the regression model accounts for per degree of freedom. On the other hand, the residual or error mean square is approximately 0.748, signifying the extent of unexplained variance per degree of freedom inherent in the dataset. The F-statistic (F) is a crucial indicator, representing the ratio of the mean square for regression to the mean square for error.

In this particular analysis, the calculated F-statistic is substantial at 19.509, suggesting a notable difference between the variances explained by the regression model and those attributed to random error.

Finally, the Significance (Sig.) value, denoted as "<.001," carries significant weight. This p-value indicates highly significant results. In practical terms, it implies that the regression model, which incorporates LOKSCT as a predictor, exerts a profound and statistically significant influence in elucidating the variances observed within the LOAD variable. These outcomes collectively convey that the regression model, featuring LOKSCT as a predictor, is statistically significant in its capacity to explicate the variability inherent in the LOAD variable. This implies that LOKSCT plays a significant and influential role in shaping the LOAD variable, rendering the model a suitable and effective fit for the data under examination.

In summary, this analysis suggests a strong and statistically significant relationship between the level of knowledge and expertise in selected technologies (LOKSCT) and the adoption levels of these technologies within IT audit departments (LOAD). It implies that LOKSCT is a significant factor in explaining variations in technology adoption levels, supporting the investigation into deviations between current Internal Auditor skills and desired next-generation competencies.

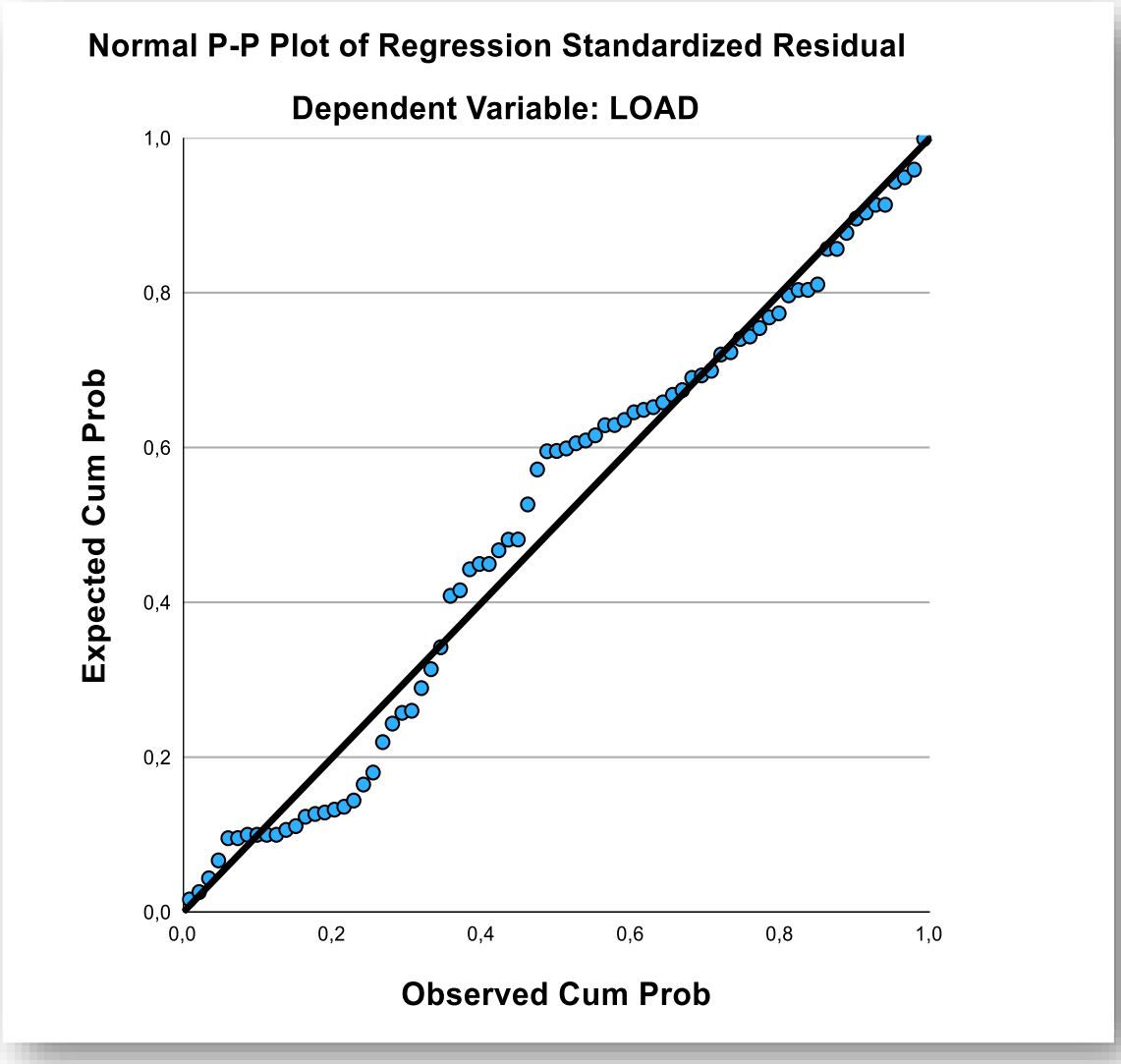



*Figure 4.3 ANOVA Normal P-P Plot of Regression Standardised residual - Dependent Variable (LOAD)*

## 4.5 Internal Consistency and Factor analysis

### 4.5.1 Internal Consistency

*Table 4.13 Reliability and Validity Statistics*

| Factor | Cronbach's Alpha | KMO | Bartlett's Test | |
|---|---|---|---|---|
| | | | Approx. Chi-Square | Sig. |
| LOKSCT | .91 | .853 | 468,710 | <.001 |
| LOAO | .91 | .881 | 522,677 | <.001 |
| LOAD | .93 | .876 | 617,881 | <.001 |
| ITAuditSC | .85 | .848 | 118,270 | <.001 |
| Soft Skills and Competencies | .85 | .803 | 294,169 | <.001 |
| Technical skills and Competencies | .93 | .884 | 625,896 | <.001 |

One of the commonly used measures of internal consistency reliability to assess how well the items within a scale of questionnaire correlate with each other is the Cronbach's alpha coefficient. Cronbach's alpha coefficient assumes that all the items in a scale measure a single underlying construct therefore should be correlated with one another (Bland & Altman, 1997) . Generally, a Cronbach's alpha value of 0.70 and above is considered acceptable by many researchers (Bland & Altman, 1997) (Meixner & Igonor, 2018) (Sanders-Jackson & Cappella, 2011) (Vickers, 2017)

The Internal Consistency reliability of the survey instrument was 0.96. This indicates Highly strong Internal consistency among the variables measuring whether there is any misalignment in the acquired IT audit skills and competencies in relation to the required skills and competencies in technologically advanced organisations. This suggests that the reliability of measurement of IT audit skills and competencies is consistent and dependable. This high internal consistency reliability suggests that the variables chosen to assess misalignments between current IT audit skills and competencies and the required skills and competencies for technologically advanced organisations are coherent and reliable. This supports the idea that the survey captures meaningful information related to the research question. The Cronbach alpha of .91 for both the LOKST and LOAO component indicates that there is 91% chances that the items within each factor are measuring the levels of knowledge and expertise in the use of each of the identified technology included in the Factor and the level of organisational level adoption of the technology. The level of adoption on a

departmental level is noted to be 93% reliable as indicated by the Cronbach alpha of .93 for the LOAD component. The Cronbach's alpha value of .85 for the Soft Skills competencies component indicates a strong level of consistency. This suggests that the items (variables) grouped within this component are measuring the same underlying construct very well and correlate with each other well, meaning they can be concluded to be internally consistent and reliable. For the Technical skills and competencies component, Cronbach's Alpha was recorded to be .93, indicating excellent internal consistency within the component. While for the ITAuditSC components, the assumptions made for the Soft Skills and competencies as it relates to the strength of the internal consistency can be concluded to be the same.

### 4.5.2 Factor analysis

The Kaiser-Meyer Olkin (KMO) is used to measure the adequacy of the data for factor analysis. Generally, a KMO value above .80 are considered suitable. In order to assess whether the dataset used to create these components is suitable, the KMO measure of sampling adequacy was utilised where for the six(6) Factors Soft Skills and competencies, Technical skills and competencies, ITAuditSC, LOKST, LOAO, and LOAD KMO of (.803, .884,.848, .853, .881, and .876) was recorded. Suggesting that the data within these variables making up the components are considered "meritorious" as in, the variables Indicates that the patterns of correlation among variables within each of these components have a huge amount of shared variance making it quite suitable for factor analysis. This supports the idea that they can be grouped into meaningful components. Lastly, we looked at the significance levels from the Bartlett's Test to evaluate the statistical significance for all six (6) component loadings calculated at <.001, indicating that the observed relationships between items (variables) within the components are unlikely to have occurred by chance. Furthermore, these significant correlations indicate that the variables within each subset are related and potentially measure coherent constructs. This supports the idea that the variables within each component are interrelated and suitable for further analysis to create meaningful scales or components.

From the analysis provided, the results suggest that the Soft skills and competencies component has a good internal consistency but a slightly lower but generally acceptable KMO value compared to the other five (components). This might indicate

that the correlations between the variables in this component are somewhat weaker. The technical skills and competencies, LOAD, LOAO and LOKSC components exhibit good internal consistency, and their KMO values are generally acceptable. Overall, when looking at the high KMO values of greater than .80 and the significance levels of 99.9%, the components show strong interrelationships among their variables and solid internal consistency, suggesting that we can proceed with the assumption that the components represent meaningful constructs. With this aforementioned, we can reasonably conclude that the survey instrument is valid and reliable to answer the research question utilising the TAM method. However, for a more comprehensive assessment of the construct validity, we will also look at the correlation analysis, particularly by examining the inter-item correlation matrix. This is to further validate the construct validity (Convergent validity) and how they differ from unrelated constructs (discriminant validity).

This information collectively suggests that there are consistent moderate positive correlations between LOKSCT and LOAO and LOAD, indicating relationships between these constructs. The higher Cronbach's alpha values suggest that the items within LOAO and LOAD are internally consistent and reliable. Where the KMO values and significant Bartlett's test results support the idea that the constructs are suitable for factor analysis. The regression model analyses suggest that LOKSCT is a statistically significant predictor of both LOAO and LOAD, explaining a meaning proportion of the variance in these constructs. Overall, this points towards a valid, reliable, and interrelationships of the constructs, and the regression models reinforce the idea that LOKSCT plays a significant role in predicting both LOAO and LOAD.

These findings indicate consistent, moderate positive correlations between LOKSCT and LOAO and LOAD, signifying robust relationships among these constructs. The higher Cronbach's alpha values demonstrate that the items within LOAO and LOAD exhibit internal consistency and reliability. Moreover, the KMO values and significant Bartlett's test results support the suitability of the constructs for factor analysis. Results from the regression model analyses underscore that LOKSCT is a statistically significant predictor for LOAO and LOAD, elucidating a substantial proportion of the variance within these constructs. In summary, these outcomes affirm the validity,

reliability, and interrelationships among the constructs, with the regression models reinforcing the pivotal role of LOKSCT in predicting both LOAO and LOAD.

## 4.6 Non-Parametric Analysis

A nonparametric analysis was conducted to explore the relationships and disparities between six key variables: Soft Skills and competencies, Technical Skills and competencies, IT Audit Skills and competencies, Level of Knowledge, Skills, and Competencies in Using the Technology (LOKSCT), Level of Adoption of the Technology in the Organization (LOAO), and Level of Adoption of the Technology in the Department (LOAD). Nonparametric analysis was chosen to ensure robust statistical insights, as the data did not conform to the assumptions of normality and parametric tests. The objective was to gain a deeper understanding of the relationships and competencies in the context of IT audit professionals, providing valuable insights into aligning skills and knowledge in a rapidly evolving technological landscape.


*Figure 4.4 Related-samples Friedman's Two-Way Analysis of Variance by Ranks*

The highest mean rank is observed for "Soft Skills and Competencies," indicating that, on average, IT auditors have the highest perceived competency in soft skills. These observations are significant as they align with the top ten core competencies outlines for Internal Auditors within the IIA Competency (IIA Global Competency Framework, 2013). Furthermore, these findings substantiate the results from a 2021 collaboration between the Internal Audit Foundation and Deloitte, where Internal Audit respondents revealed their highly developed competencies in essential knowledge areas pertinent to their profession. However, contrastingly, they also identified critical resource gaps in soft skills. It can be inferred that, since 2021, there has been an increasing adoption of the report's recommendation to continuously assess staff competencies and identify opportunities for filling skill gaps within Audit teams, particularly within the financial services sector, and specifically in the context of soft skills development.

"Technical Skills and Competencies" have a lower mean rank than soft skills, suggesting that IT auditors, on average, have lower perceived competency in these

areas than soft skills. While "LOKSCT" has a lower mean rank than the skills and competencies variables, indicating that, on average, IT auditors have a lower perceived level of knowledge and expertise in the use of technology than their skills and competencies. Both "LOAO" and "LOAD" have mean ranks lower than the skills and competencies variables, suggesting that, on average, the level of technology adoption at both the organisational and departmental levels is perceived to be lower than IT auditors' skills and competencies or the respondents were not. The mean ranks indicate that IT auditors are highly skilled and competent in the 20 identified core competencies for IT Audit professionals, especially in soft skills. However, the mean ranks for "LOKSCT," "LOAO," and "LOAD" are lower than those measuring the core skills and competencies of IT auditors.

This suggests that, on average, IT auditors have a higher level of core skills and competencies than the level of expertise required of IT auditors in technology adept organisations. These findings support the hypothesis that there is misalignment between the skills and competencies that IT audit professionals possess, and the skills and competencies required by technologically advanced organisations. This misalignment persists even in the face of calls to bridge knowledge gaps through innovative training initiatives or recruiting specialised professionals, notably IT experts. Additionally, it prompts us to critically examine the assertions made by respondents in the 2019 study conducted by Christ et al (2019), which suggested that Internal Auditors are more prepared to respond to future innovations and changes compared to innovations already integrated within their organisations.

*Table 4.14 Pairwise Comparisons*

| Pairwise Comparisons | | | | | |
|---|---|---|---|---|---|
| Sample 1-Sample 2 | Test Statistic | Std. Error | Std. Test Statistic | Sig. | Adj. Sig.[a] |
| LOAD-LOKSCT | ,273 | ,302 | ,905 | ,366 | 1,000 |
| LOAD-LOAO | ,370 | ,302 | 1,228 | ,220 | 1,000 |
| LOAD-Technical Skills and Competencies | 1,773 | ,302 | 5,879 | <.001 | ,000 |
| LOAD-Soft Skills and Competencies | 3,403 | ,302 | 11,285 | <.001 | ,000 |
| LOKSCT-LOAO | -,097 | ,302 | -,323 | ,747 | 1,000 |
| LOKSCT-Technical Skills and Competencies | 1,500 | ,302 | 4,975 | <.001 | ,000 |
| LOKSCT-Soft Skills and Competencies | 3,130 | ,302 | 10,381 | <.001 | ,000 |
| LOAO-Technical Skills and Competencies | 1,403 | ,302 | 4,652 | <.001 | ,000 |
| LOAO-Soft Skills and Competencies | 3,032 | ,302 | 10,058 | <.001 | ,000 |
| Technical Skills and Competencies-Soft Skills and Competencies | 1,630 | ,302 | 5,406 | <.001 | ,000 |

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

The analysis involved pairwise comparisons between several variables related to IT auditors' skills, competencies, and technology adoption within their organisation. The comparisons were conducted to examine whether these variables had statistically significant differences. The significance level for all tests was set at $p < .05$, and Bonferroni correction was applied to adjust for multiple tests. The comparison between the "Level of Adoption of the Technology in the Department (LOAD)" and the "Level of Knowledge, Skills, and Competencies in using the Technology (LOKSCT)" suggests that the distributions are not significantly different ($p = .366$, adjusted $p = 1.000$).

The comparison between "LOAD" and "Level of Adoption of the Technology in the Organisation (LOAO)" also did not yield a statistically significant difference ($p = .220$, adjusted $p = 1.000$). There was a statistically significant difference between "LOAD" and "Technical Skills and Competencies" ($p < .001$, adjusted $p = .000$), suggesting that the level of technology adoption in the department varied significantly concerning technical skills and competencies. The similar pairwise comparisons were conducted for other variables like "LOKSCT," "LOAO," "Technical Skills and Competencies," and "Soft Skills and Competencies." In several cases, statistically significant differences were found.

Additionally, a significant difference was found between "Technical Skills and Competencies" and "Soft Skills and Competencies" ($p < .001$, adjusted $p = .000$), suggesting that technical skills were related to soft skills and competencies. These pairwise comparisons indicate that LOAD and LOKSCT are not significantly different from each other or LOAO, but they are significantly different from Technical Skills and Competencies, and Soft Skills and Competencies. Additionally, there is a significant difference between Technical Skills and Competencies and Soft Skills and Competencies. Adjusted p-values have been provided to account for multiple comparisons.

To summarise the non-parametric analysis conducted, the provided pairwise comparison data and mean ranks rejects the null hypothesis (HO) that there is no misalignment in the skills and competencies of IT auditors when compared to the required skills and competencies of IT auditors in technologically advanced Audit environments. The lower mean ranks for technology adoption levels compared to skills and competencies suggest a potential misalignment and indicate a need for further investigation and potentially aligning IT auditor skills and competencies with technological advancements in the Financial Services sector.

### 4.7 Summary

Based on the analysis and interpretation provided, we can draw the following conclusions regarding the hypothesis that "There is misalignment between IT audit skills and competencies when compared to skills and competencies required in a technologically advanced Audit environment":

The correlation analysis indicates that there are consistent moderate positive correlations between the level of knowledge, skills, and competencies in using technology (LOKSCT) and both the level of organisational adoption of technology (LOAO) and the aggregated level of technology adoption in the department (LOAD). These correlations suggest a relationship between IT auditors' knowledge and expertise in using technology and the technology adoption levels in their organisations.

The regression analysis further supports the hypothesis by demonstrating that LOKSCT is a statistically significant predictor of LOAO and LOAD. This means that the level of IT auditors' knowledge and expertise in using technology can explain a

meaningful proportion of the variance in technology adoption levels. The adjusted R-square values suggest that LOKSCT contributes significantly to explaining this variance.

The high Cronbach's alpha values for LOKSCT and LOAO (both .91) indicate a strong level of internal consistency among the variables measuring these constructs. Additionally, Cronbach's alpha values for the other components, including LOAD, IT audit skills and competencies, and soft skills and competencies, are also high, indicating strong internal consistency. The Kaiser-Meyer Olkin (KMO) values and Bartlett's Test results support the suitability of the data for factor analysis, indicating that the constructs are meaningful and interrelated.

The Friedman's Test results suggest there are statistically significant differences among the distributions of soft skills and competencies, technical skills and competencies, IT audit skills and competencies, LOKSCT, LOAO, and LOAD. Specifically, LOAD and LOKSCT are not significantly different from each other or LOAO, but they are significantly different from Technical Skills and Competencies, IT Audit skills and competencies, and Soft Skills and Competencies. This indicates that there are differences in the levels of technology adoption and IT audit skills and competencies.

In conclusion, the analysis provides substantial evidence to support the hypothesis that there is a misalignment between IT audit skills and competencies and the skills and competencies required in a technologically advanced audit environment. IT auditors' knowledge and expertise in using technology appears to significantly influence technology adoption levels within their organisations, which suggests that organisations may need to align their audit teams' skills and competencies with the demands of a technologically advanced environment. Additionally, the internal consistency and factor analysis results support the validity and reliability of the data used in the analysis. In the following chapter, we will conclude what the interpretation of the results infers in answering the 5 remaining research questions as stated in Chapter 1 and provide recommendations.

# CHAPTER 5
# FINDINGS, RECOMMENDATIONS AND CONCLUSION

## 5.1 Introduction

In the previous chapter, we discussed how the data was collected and prepared for analysis, detailing the analysis and interpretation of responses received. This chapter first gives a high-level overview of the study's objective, highlighting the main research question and how it was broken down into sub-questions. Then, it provides a summary of the remaining sub-questions that the study attempted to answer. Then, a focus on discussing the results observed as they relate to the empirical literature, training and upskilling methodologies and frameworks that focus on improving IT audit practices within the financial services sector, in academic institutions, and within-subject professional bodies' certification curriculum is made. Then, an overview of any delimitation and limitations the study faced is addressed, giving suggestions for further research and providing concluding remarks.

## 5.2 Overview of the Study Objectives

The primary aim of this study was to examine whether the skills and competencies of IT audit professionals are congruent with the contemporary demands of an increasingly technology-driven landscape. This inquiry was driven by the dynamic nature of the internal control environment, which has adapted to the heightened and evolving risk landscape and is largely influenced by the introduction of novel technological advancements within the South African financial services sector. Consequently, the need to continuously align the proficiencies of IT audit professionals with emerging technological trends has become imperative to uphold the quality of audit and advisory services provided to organisations within the financial services sector. Additionally, this alignment is crucial for ensuring that the control environments in these organisations remain forward-looking in their approach to managing the ever-evolving risk landscape. The study sought to investigate this objective by outlining the following specific objectives, which are elaborated upon in Chapter 1 (section 1.2.5.):

- To ascertain the advanced technologies in the financial services sector and explore their impact on IT audit skills and competencies.

- To assess the skills and competencies of IT audit professionals in the financial services sector.
- To establish the nature of skills that are prerequisites for the financial services sector in South Africa to deliver quality IT audits.
- To establish the nature of competencies that are prerequisites for the financial services sector in South Africa to deliver quality IT audits.
- To identify any disparities between IT audit professionals' current skills and competencies and the skills and competencies required for adapting to Rapid Technology Advancement.
- To establish the training needs in the financial services sector that will enable IT audit professionals to have these skills and competencies.

## 5.3 Methodological Procedures Employed

The research was grounded in the positivism paradigm, serving as the foundational framework for this study. It employed a descriptive quantitative approach, utilising a non-experimental cross-sectional research design to collect and analyse data. A survey questionnaire was employed for data collection, which encompassed three distinct sections:

*Part 1: Biographic Information & Employment History*

*Part 2: Acquired Audit Skills and Competencies.*

*Part 3: Knowledge and Competence with Advanced Technologies*

One hundred and eight questionnaires were gathered from professionals occupying positions in IT risk and controls, IT advisory, IT audit, IT governance, and IT consulting within the financial services sector in South Africa. The survey data underwent comprehensive statistical analysis, including descriptive statistics, Inter-item correlation analysis, Chi-Square tests, Kendall's tau-b and Spearman Correlation analysis, Linear regression, ANOVA, related-samples Friedman's two-way analysis of variance by ranks, and pairwise comparisons. The survey instrument was tested for validity and reliability through factor analysis, applying the Kaiser-Meyer Olkin (KMO), Kronbach's Alpha, and Bartlett's Test of Sphericity. This extensive analysis was

conducted using SPSS, complemented by Python, particularly for descriptive statistics and data preparation.

## 5.4 Summary of Research Findings

This section of the study aims to provide a comprehensive overview of the research findings achieved in alignment with the study's objectives. The primary goal of this segment is to synthesise and present the principal results, observations, and conclusions derived from the extensive data collection and analysis process conducted during the research project.

The objectives, initially established at the commencement of this study, were meticulously crafted to guide the investigation into specific areas of inquiry. These objectives functioned as a roadmap, facilitating a systematic exploration of various facets of the effects of rapid technology advancements in IT audit skills and competencies in the financial services sector in south Africa, thus enabling a methodical examination of critical factors influencing or contributing to the Misalignment in current skills and competencies of IT auditors when compared to the prerequisite skills and competencies in a technologically advanced financial services environment. A thorough literature review was conducted to establish a robust theoretical foundation, addressing existing knowledge gaps and informing the research design.

By methodically analysing and interpreting these findings, valuable insights into the alignment of skills and competencies of IT audit professionals with those required in a technologically advanced landscape were derived. This section will serve as a platform to present these findings in an organised manner, ensuring clarity and comprehension for readers.

While this section offers a concise summary of key findings, it is important to emphasise that it does not encompass the areas explored within this study. Instead, it summarises the findings most pertinent to achieving our stated objectives. Doing so aims to provide a succinct yet informative account of our research outcomes.

By examining these findings, researchers, practitioners, policymakers, and other stakeholders will gain a deeper understanding of the implications of rapid technological

advancement within their respective domains. Furthermore, these findings may serve as a foundation for future studies seeking to delve further into specific aspects related to the impact of rapid technological advancement on IT audit skills and competencies within the financial services sector in South Africa.

### 5.4.1 Advanced technologies prevalent within the financial services sector and their Impact on IT audits.

The first objective of this research was to identify advanced technologies prevalent within the financial services sector and to investigate their influence on the skills and competencies required in the scope of IT audit. Through a comprehensive review of academic literature and industry research, the following technologies emerged as the most disruptive within the financial services sector, with some already demonstrating practical use cases:

***Robotics Process Automation (RPA):*** The adoption of RPA has gained significant traction in financial services. It is used to streamline repetitive processes and tasks in the customer value proposition within financial services, prompting IT auditors to develop expertise in assessing and auditing automated processes. IT auditors could also leverage this technology within the Internal Audit department to automate repetitive mundane tasks, allowing auditors to focus on more complex analysis and risk assessment activities.

***Machine Learning (ML):*** Machine learning algorithms are being integrated into financial systems, necessitating IT auditors to possess the knowledge and skills to evaluate ML-based models for accuracy and compliance. They also present a unique opportunity for IT audit professionals to utilise these algorithms to facilitate advanced data analysis that would enable auditors to identify patterns, anomalies, and trends within large datasets that were previously difficult to detect manually, which would enable a forward-looking instead of a re-active approach to assessing new risks brought by the rapid technological advancements within the Financial Services and enable fraud detection.

***Artificial Intelligence (AI):*** AI systems can mimic human intelligence by processing natural language, recognising images and making decisions based on complex data analysis. AI systems in financial services require IT auditors to understand AI-driven

decision-making processes, data handling, and ethical considerations by acquiring knowledge of AI frameworks and algorithms to assess control mechanisms embedded within these systems effectively.

***Process Mining:*** This technology analyses process data for efficiency and compliance evaluations. Through analysing event logs generated by business processes, IT auditors could identify deviations, bottlenecks, and inefficiencies within business processes. This is achievable through understanding process mining techniques to optimise internal controls and improve operational performance for businesses within the financial services sector in South Africa.

***Advanced Analytics:*** Advanced analytics allows deep insights into complex datasets through sophisticated statistical methods and mathematical algorithms. The use of advanced analytics demands that IT auditors possess the ability to interpret complex data outputs and assess their impact on financial operations.

***Data Mining:*** Through the comprehensive analysis of substantial volumes of structured or unstructured data, data mining empowers organisations to unveil intricate patterns or correlations that may remain concealed when employing conventional investigative approaches. In IT audit, a vital competency lies in utilising data mining tools and techniques. Data mining requires IT auditors to harness their expertise to extract valuable insights from extensive financial datasets. This expertise necessitates the development of skills related to the recognition of data patterns, a capability crucial for effectively identifying emerging risks. Additionally, data mining equips IT auditors with proficiency in anomaly detection, a skill instrumental in pinpointing potentially fraudulent activities within financial data.

***Big Data:*** With the proliferation of digital information, big data technologies enable organisations to store, process and analyse vast amounts of structured and unstructured data. Managing and auditing big data environments necessitates IT auditors to adapt their skills to assess the security, integrity, and value of large-scale data repositories through knowledge of big data frameworks and analytics tools.

***Internet of Things (IoT):*** The term IoT, or Internet of Things, denotes a network comprising interconnected physical devices equipped to gather and share data. With the financial services sector increasingly embracing IoT devices by integrating them

into their systems, IT auditors must adjust their knowledge base, skills, and competencies. This adaptation is essential for their role in evaluating data transmission pathways, security measures, and compliance considerations related to the communication protocols and operational objectives governing these interconnected objects.

***Nanotechnology:*** This emerging field revolves around manipulating matter at the molecular or atomic scale. Although its influence on IT audit skills is evolving, IT auditors should proactively acquaint themselves with potential nanotechnology applications within the financial services sector. The nascent utilisation of nanotechnology in finance mandates that IT auditors confront unique security challenges and considerations related to safeguarding data in transactions occurring at the nanoscale.

***Drones:*** Drones present promising prospects for augmented surveillance and monitoring capabilities, notably within domains like physical security and asset tracking. IT auditors must acquire expertise in drone technologies and their ramifications on control frameworks. Integrating drones into asset assessment and surveillance activities within the financial sector compels IT auditors, to systematically evaluate drone technology's associated risks and advantages.

***Blockchain:*** The decentralised ledger technology known as blockchain harbours the capacity to bring about fundamental transformations in financial services, encompassing transactional processes, identity authentication, and supply chain oversight. IT auditors must cultivate proficiency in blockchain frameworks, equipping them with the capability to scrutinise the robustness of these systems. As the utilisation of blockchain gains traction within financial transactions, it becomes imperative for IT auditors to undertake thorough evaluations of the integrity and security underpinning blockchain-driven procedures.

***Machine Language Processing:*** Machine language processing empowers computers to comprehend and engage in natural language communication with humans and fosters seamless interactions between individuals and machines. For IT auditors, remaining current with the progressions in machine language processing techniques is essential for the proficient evaluation of conversational AI systems

during audits. The proficiency required of IT auditors extends to comprehending and auditing machine language processing systems, which enhance customer interactions and enable comprehensive data analysis.

These findings illuminate the evolving landscape of technology in the financial services sector; these disruptive technologies have significant implications for IT audit skills and competencies within the financial services sector. They underscore the critical role of IT audit skills and competencies in ensuring these technologies' security, compliance, and effectiveness. IT auditors must continually adapt their knowledge and abilities to address the challenges and opportunities presented by these disruptive technologies.

### 5.4.2 Current skills and competencies possessed by IT audit professionals in the financial services sector?

The subsequent phase of our research endeavours involved an exhaustive exploration of existing literature and industry studies with the primary objective of ascertaining the competencies and skillsets that currently characterise IT audit professionals. To accomplish this, our investigation encompassed a meticulous examination of the competencies outlined within the Institute of Internal Auditors' (IIA) Audit Competency Framework. Within this comprehensive framework, a total of 28 distinct knowledge domains were delineated, as presented below:

*Table 5.1 Summary of Internal Auditors Competencies*

| | **Knowledge Area** |
|---|---|
| | Ethical behaviour |
| | Due professional care |
| | Individual objectivity |
| | Organisational independence |
| | Internal control |
| | Leadership and Communication |
| | Reporting |
| | Professionalism |
| | Professional development |
| | Leadership and Communication |
| | Soft skills |
| | Risk management |
| | Mission of internal auditing |
| | Audit plan and coordinating assurance efforts |
| | Engagement outcome |
| | Relationship building |
| | Engagement fieldwork |

| | Knowledge Area |
|---|---|
| | Engagement planning |
| | Internal audit charter |
| | Common business processes |
| | Internal audit strategic planning and management |
| | Organisational governance |
| | Accounting and finance |
| | Security and privacy |
| | Strategic planning and management |
| | Data Analytics |
| | IT control frameworks |
| | Fraud (e.g., assessment and investigation) |
| | Quality assurance and improvement program |
| | Agile auditing methodologies |
| | Social responsibility and sustainability |

The meticulous examination of the competencies embodied within the IIA's Audit Competency Framework has unveiled a comprehensive spectrum of knowledge domains that delineate the proficiencies required by IT audit professionals within the financial services sector. These competencies encompass various areas, from ethical behaviour and due professional care to the strategic planning and management of internal auditing functions. Moreover, they underscore the multifaceted nature of the IT audit profession, where a nuanced blend of technical skills, interpersonal aptitudes, and ethical principles is essential for ensuring the effectiveness and integrity of audit processes within the financial services domain. As IT audit continues to evolve with technological advancements and regulatory changes, cultivating and maintaining these competencies remain imperative for professionals operating in this dynamic and vital sector.

The literature review underscored the imperative for IT auditors to possess a strong technical foundation, aligning with their operational backgrounds and remaining abreast of developments that mirror the rapid pace of technological evolution and adoption. Consequently, this study concentrates on the exploration of technical skills and competencies, alongside the identification of the top ten essential soft skills and competencies that serve as the cornerstone for proficient IT audit professionals, as highlighted below:

- Self-motivation, determination and confidence

- Ability to divide your time between work and continual professional development
- Problem identification and solution skills
- Meticulous attention to detail
- Communication skills
- Conflict resolution/negotiation skills
- Organisational skills
- Industry regulatory and standards changes
- Accounting framework tools and techniques
- IT/ICT Frameworks, tools and techniques
- Business acumen
- Change Management skills
- Critical thinking skills
- Use of CAAT (Computer-assisted auditing tools)
- Data collection and data analytics
- Business process analysis
- Governance, risk, and control tools and techniques
- Forecasting skills, Identifying types of controls
- IT and accounting system knowledge
- Operational and management research skills
- Statistical sampling
- Forensic skills/ Fraud awareness.

### 5.4.3 The nature of skills that are prerequisite for the financial services sector in South Africa to deliver quality IT audits.

During the investigation into the nature of skills prerequisite for an IT Auditor within the financial services sector in South Africa, where there has been high adoption of technology advancements, several key attributes and characteristics were evaluated

through literature. These included the skill type (whether a technical skill or a Soft skill), the proficiency levels (assessed through the level of expertise in the particular skill), and the relevance of the skill in the IT audit profession, particularly within a Financial Services landscape. The literature revealed several important findings. The results indicated that 14 highly regarded skills were noted to be pertinent throughout the literature examined.

- Problem identification and solution skills are soft skills that focus on identifying issues and developing effective solutions. These are crucial for identifying and addressing audit findings and operational challenges effectively. The literature, both academic and industry, recognises and emphasises that the proficiency of this skill is at an advanced level for IT audit professionals in a Technologically geared financial services environment to identify complex issues and propose innovative solutions.

- Soft skills, including verbal and written communication, were deemed essential for effectively conveying audit findings and recommendations to stakeholders. There was a need for an advanced proficiency level of communication for IT audit professionals for clear, concise and persuasive communication.

- Conflict resolution and negotiation skills, which are soft skills, were identified as valuable assets for addressing conflicts or disagreements that may arise during audits and negotiating with stakeholders. IT Audit professionals proficiently advanced in this skill were noted to be highly capable of managing disputes, addressing disagreements during audits and ensuring cooperation among team members and stakeholders.

- Organisational and soft skills were necessary for concurrently managing multiple audits and ensuring efficient workflow. Advanced proficiency in this skill ensures efficient audit planning and execution through time management, task prioritisation and organisation.

- Possessing technical IT and accounting system knowledge is a technical skill focusing on understanding IT systems and accounting principles. Advanced

levels of proficiency were found to be indispensable for understanding complex systems and evaluating their effectiveness, which was highlighted as an essential skill for comprehending the systems being audited and identifying control weaknesses.

- Using computer-assisted auditing tools (CATTs) is also a technical skill for using specialised audit software for data analysis. It was emphasised as an essential skill that IT audit professionals needed to be highly proficient in to effectively streamline audit processes and enhance efficiency by automating data analysis and testing.

- Business process analysis skills can be regarded as technical analytical skills that involve assessing and optimising business processes. This skill was identified as a critical skill requiring advanced levels of proficiency for IT audit professionals to comprehend organisational workflows and evaluate control mechanisms to understand and improve the efficiency of audited business processes.

- Forecasting skills also deemed technical, analytical skills that focus on predicting future trends and outcomes, were highlighted as important for assessing future risks and opportunities within the financial services industry and audit scope at an advanced proficiency level for accurate forecasting.

- Identifying types of controls is a technical skill that involves recognition and assessment of internal controls. Advanced proficiency levels in this skill set were recognised as fundamentally important to identify and assess the adequacy and effectiveness of control frameworks in mitigating risks.

- Operational and management research skills are technical, analytic skills related to operational and management data and were considered vital for conducting thorough assessments of operational processes within financial institutions, which requires an advanced proficiency level.

- Statistical sampling techniques are technical skills involving using statistical techniques to select and analyse data samples. An advanced proficiency level in this skill set was highlighted as an important skill that assists in

representative data collection and drawing accurate conclusions from limited statistically valid samples.

- Intermediate to advanced levels of forensic skills and fraud awareness were identified as necessary technical abilities to detect fraudulent activities or irregularities during audits.

- Meticulous attention to detail is a soft skill that emerged as a key attribute expected from IT audit professionals. It emphasises the need for thoroughness and precision in spotting even minor discrepancies and anomalies during audits, given the nature of their work.

- Intermediate to advanced levels of data collection and data analytics capabilities were noted as crucial skills for analysing large volumes of data efficiently and extracting meaningful insights to support audit findings.

Overall, these findings highlight the diverse range of skills and competencies expected from IT audit professionals in the financial services industry in South Africa. These skills encompass technical knowledge and include interpersonal, analytical, and problem-solving abilities necessary to deliver quality IT audits.

### 5.4.4 The nature of competencies that are prerequisites for financial services sector in South Africa to deliver quality IT audits

While still reviewing the literature, to try to get to the top competencies that are deemed a prerequisite to the financial services sector in South Africa in delivering quality IT audits in a technology-advanced landscape, the results indicated that there were a total of nine competencies that were deemed a prerequisite for IT audit professionals.

- An advanced level of understanding of accounting frameworks, tools, and techniques relevant to auditing. This involves a deep knowledge of financial processes, procedures, and regulations within the financial services industry in South Africa, which is crucial for assessing and evaluating financial data accurately and ensuring accurate financial reporting within IT audits.

- Another important competency identified is self-motivation, determination, and confidence, which emphasises personal qualities like motivation and

self-assurance, which is a soft competency. IT audit professionals must possess a high proficiency and a strong drive to maintain motivation, determination, and confidence in challenging audit environments, continuously improve their skills and stay updated with emerging technologies and trends. They should have the confidence to challenge existing practices and propose innovative solutions.

- The ability to effectively divide time between work responsibilities and continuous professional development was also emphasised in the literature. IT audit professionals must allocate time for ongoing learning, attend training programs, and stay updated with industry changes. Balancing work responsibilities and continuous learning ensures auditors stay up-to-date and improve their skills.

- An advanced understanding of industry regulatory and standard changes was crucial for IT audit professionals. They need to stay informed about evolving regulations related to data protection, cybersecurity, privacy laws, and other relevant compliance requirements within the financial services sector. This is critical for aligning audit practices with evolving industry requirements and ensuring compliance.

- As mentioned in the literature, proficiency in IT control frameworks is another essential competency required in a technologically advanced landscape. IT audit professionals must be well-versed in different control frameworks such as COBIT (Control Objectives for Information Technology), COSO (Committee of Sponsoring Organizations of the Treadway Commission) or ISO/IEC standards (International Organization for Standardization/ International Electrotechnical Commission), the NIST framework, CIS (Center for Internet Security) Critical Security Controls, ITIL, and ITAF. These frameworks guide organisations on how to manage risks effectively. Understanding control frameworks is vital for assessing and improving IT governance and control systems.

- Business acumen focuses on understanding business operations, goals and strategies and is considered a key competency for IT audit professionals.

They need to understand the overall business operations within the financial services industry, including its strategies, goals, and objectives, to provide insights that align with the organisation's goals and priorities.

- Critical thinking skills are highly valued in IT audit professionals as they need to analyse complex systems, identify vulnerabilities or weaknesses, and provide recommendations for improvement. Critical thinking is central to identifying risks, assessing controls, and providing valuable audit recommendations, which allows IT audit professionals to consider various perspectives and make informed decisions during audits.

- IT audit professionals must be competent in governance, risk management, and control tools and techniques. Their proficiency should be advanced to effectively apply governance and risk management principles. They should be familiar with best practices related to governance structures, risk assessment methodologies, and control mechanisms. Mastering these tools and techniques is essential for evaluating the effectiveness of an organisation's risk management and control processes.

- Lastly, change management is highlighted as a crucial competency for IT audit professionals in the financial services industry. They must be highly proficient in navigating uncertainty and unexpected challenges during change. This requires them to be adaptable and flexible when implementing organisational changes. This includes effectively communicating changes, managing resistance, ensuring smoother transitions, minimising disruptions during change efforts, and ensuring successful implementation. This ultimately assists IT audit professionals to help guide organisations seeking to navigate and thrive in an ever-evolving business landscape introduced by technology.

Overall, these competencies identified through literature research highlight the diverse skill set required by IT audit professionals in the financial services industry in South Africa. Mastering these competencies enables them to deliver quality IT audits that address the unique challenges faced by organisations as a result of rapid advancements in technology within the financial services sector.

### 5.4.5 Alignments/ Disparities Between the Current Skills and Competencies of IT Audit Professionals and the Skills and Competencies Required for Adapting to Rapid Technology Advancement.

The following results represent the acquired audit skills and competencies of IT audit professionals in the financial services sector in South Africa, measured on a scale of proficiency as indicated in Table 5.2.

*Table 5.2 Scale of Proficiency*

| | Scale | |
|---|---|---|
| Low - Moderate Proficiency | 1 | Not Competent or Knowledgeable |
| | 2 | Awareness of the skill but limited knowledge |
| | 3 | Basis competence and knowledge with support from others |
| Higher proficiency | 4 | Independently competent in routine situations |
| | 5 | Independently competent in unique and complex situations |

Below is a summary of the findings for the 22 skills and competencies identified in 5.4.2.

In examining these proficiency levels, indicative of an average degree of competence and knowledge, it is evident that some of the current IT audit professionals within the financial services sector possess rather rudimentary skills in essential areas required for technologically advanced environments. This level of proficiency is likely inadequate for ensuring high-quality audits in an increasingly technology-driven audit landscape within the financial services industry. This is especially notable in the context of skills such as accounting framework tools and techniques, which were reported by 63.6% of respondents, closely followed by Governance, risk, and control tools and techniques at 62.3%, and Forensic skills/Fraud awareness at 54.5%. Even in the case of Computer-Assisted Audit Techniques (CAATs), which reached 49.4%, it still represented almost half of the respondents.

The data reveals a strong proficiency among IT audit professionals in soft skills, evident from responses indicating competence in routine and unique situations. When we aggregate responses from these two categories, it is apparent that these soft skills

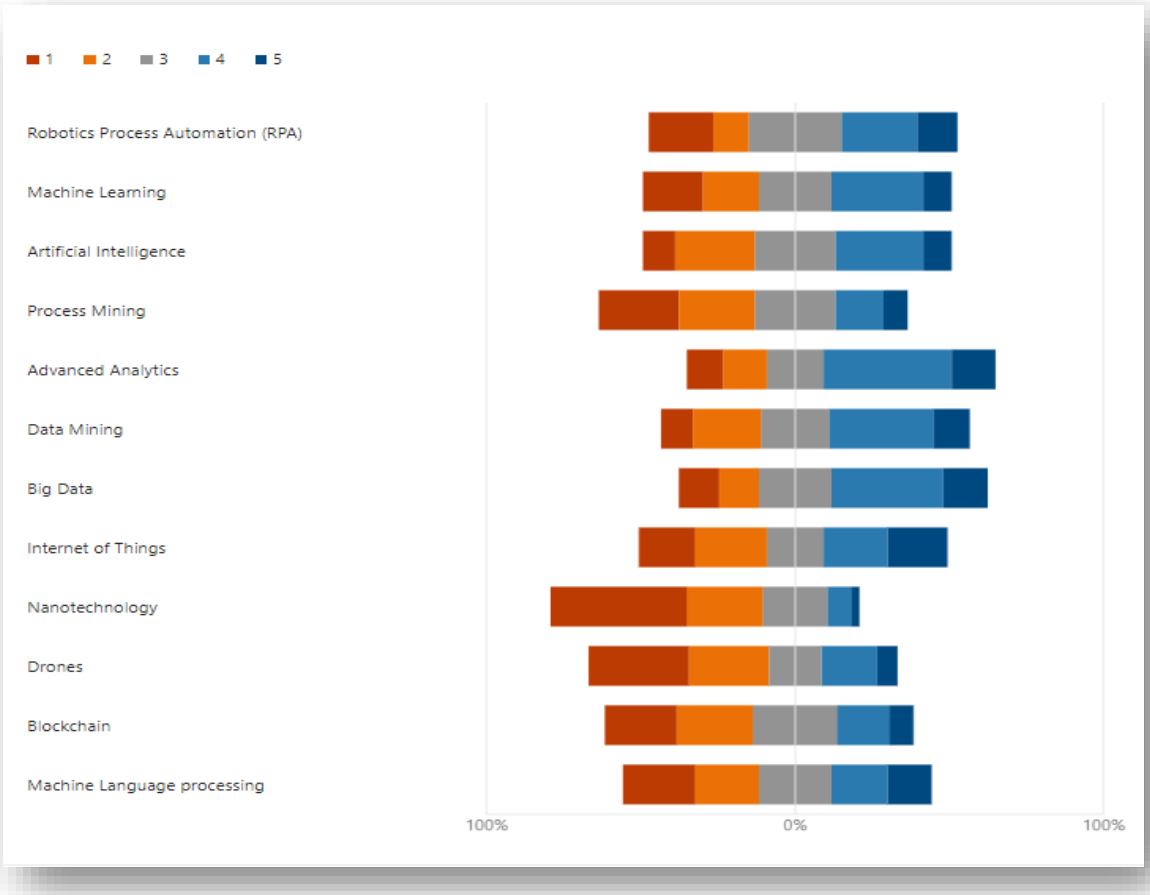
encompass Problem identification and solution skills (84.4%), Meticulous attention to detail (88.3%), Communication skills (85.7%), Business acumen (80.5%), and Critical thinking (89.6%). Notably, the importance of recognising various control types in auditing is underscored, with 81.8% of respondents demonstrating a high proficiency in this skill.

What is reassuring is that, despite the varying levels of proficiency in most of the technical skills assessed, more than 60% of respondents indicated high to expert proficiencies in technical areas such as IT/ICT frameworks, tools and techniques, Data collection and data analysis, Business process analysis, and Governance, risk, and control tools and techniques. Nevertheless, it is imperative to prioritise the development of technical competencies related to industry regulations and standards, given that only 57.1% of respondents reported independent competence in this regard. This is of particular concern due to the highly regulated nature of the financial services industry and the constant evolution of regulatory frameworks in response to the adoption of new technologies by organisations within this sector.

### 5.4.6 Technical competency levels in Technological advances within Financial Services.

#### 5.4.6.1 Technological adoption levels within the financial services sector.

The data obtained from respondents indicated the following concerning the level of technology adoption within the financial services sector, which is indicated by the data in the table below.

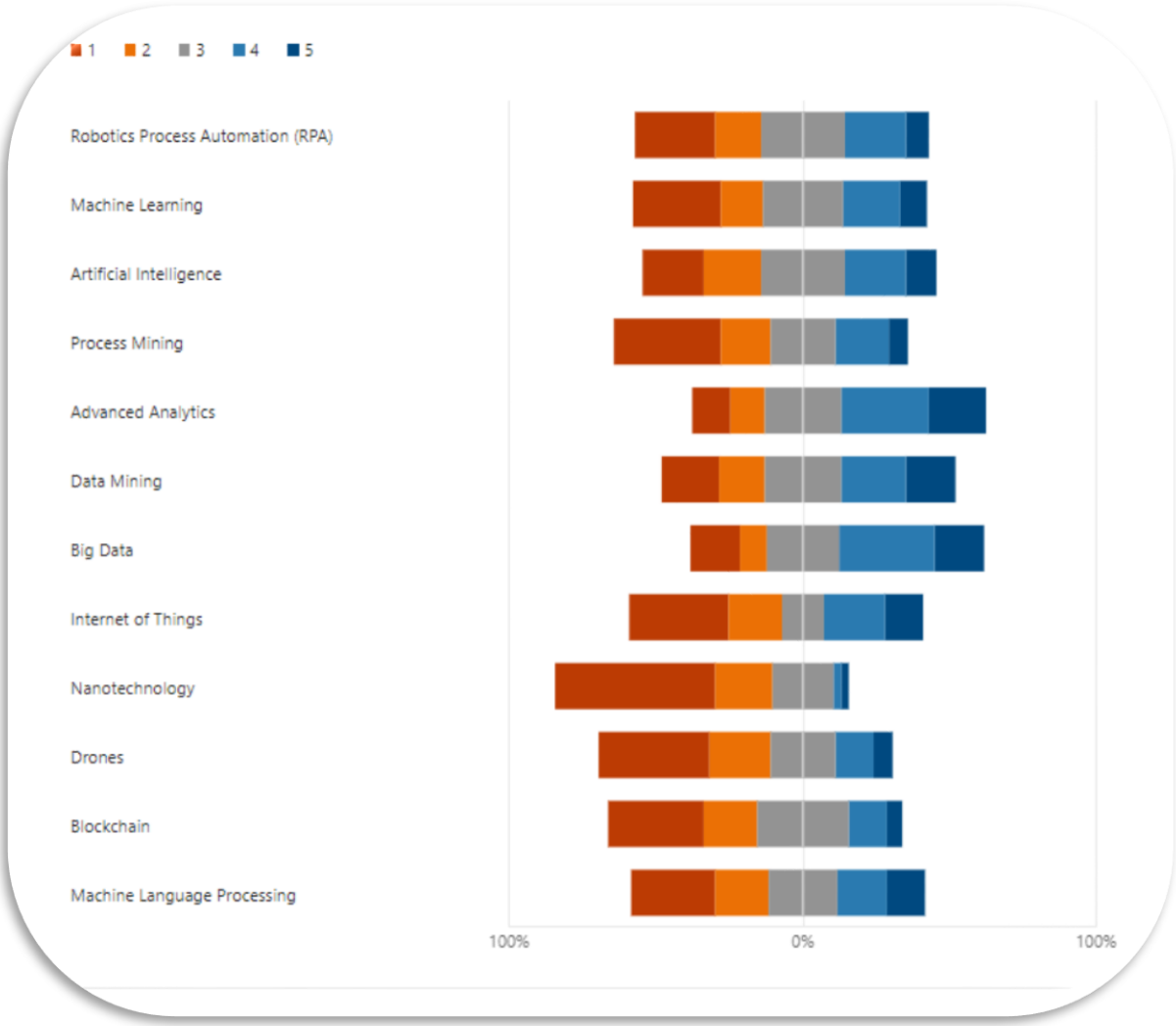



*5 - Fully adopted in all areas/ departments of the organization;*
*4 - Adopted in some areas/departments of the organization with implementation plans for the rest of the departments underway;*
*3 - Technology still in research and development phase in the organization;*
*2 - Technology not yet implemented on the organization; and*
*1 - Not aware of the technology being adopted.*

*Figure 5.1 Technology Adoption in Financial Services*

The data in Table 5.1 reveals a significant prevalence of advanced analytics technologies, data mining, big data, and the Internet of Things (IoT) within financial services organisations. Notably, 44.2% of survey respondents indicated a lack of awareness regarding adopting nanotechnology in their respective organisations. A distinctive finding within the dataset is that over 20% of respondents expressed unfamiliarity with Robotics Process Automation (RPA), Process Mining, drones, blockchain, and natural language processing (NLP).

### 5.4.6.2 Technological adoption levels within Audit Departments provide IT audit assurance to Organisations within financial services technology.




*5 - Fully adopted in the department;*
*4 - Adopted to some extent;*
*3 - Technology still in research and development phase in the department;*
*2 - Technology not currently used by the department; and*
*1 - Not aware of any adoption of the technology.*

*Figure 5.2 Technology Adoption in Financial Services*

Upon examining the responses concerning the integration of nanotechnology, it was unsurprising to observe that most respondents, accounting for 54.5%, lacked awareness regarding its adoption within their respective Audit departments. Nonetheless, a noteworthy observation is the 10.3% increase in this percentage when contrasted with responses concerning the adoption of nanotechnology within the organisations to which the respondents were rendering IT audit assurance. Additionally, the data underscores a significant revelation: all 12 technologies exhibit varying degrees of implementation within audit departments in the financial services sector.

#### 5.4.6.3 Technological adoption levels within the financial services sector.

The data obtained from respondents indicated the following with regard to the level of technology adoption within the financial services sector, which is indicated by the data in the table below.

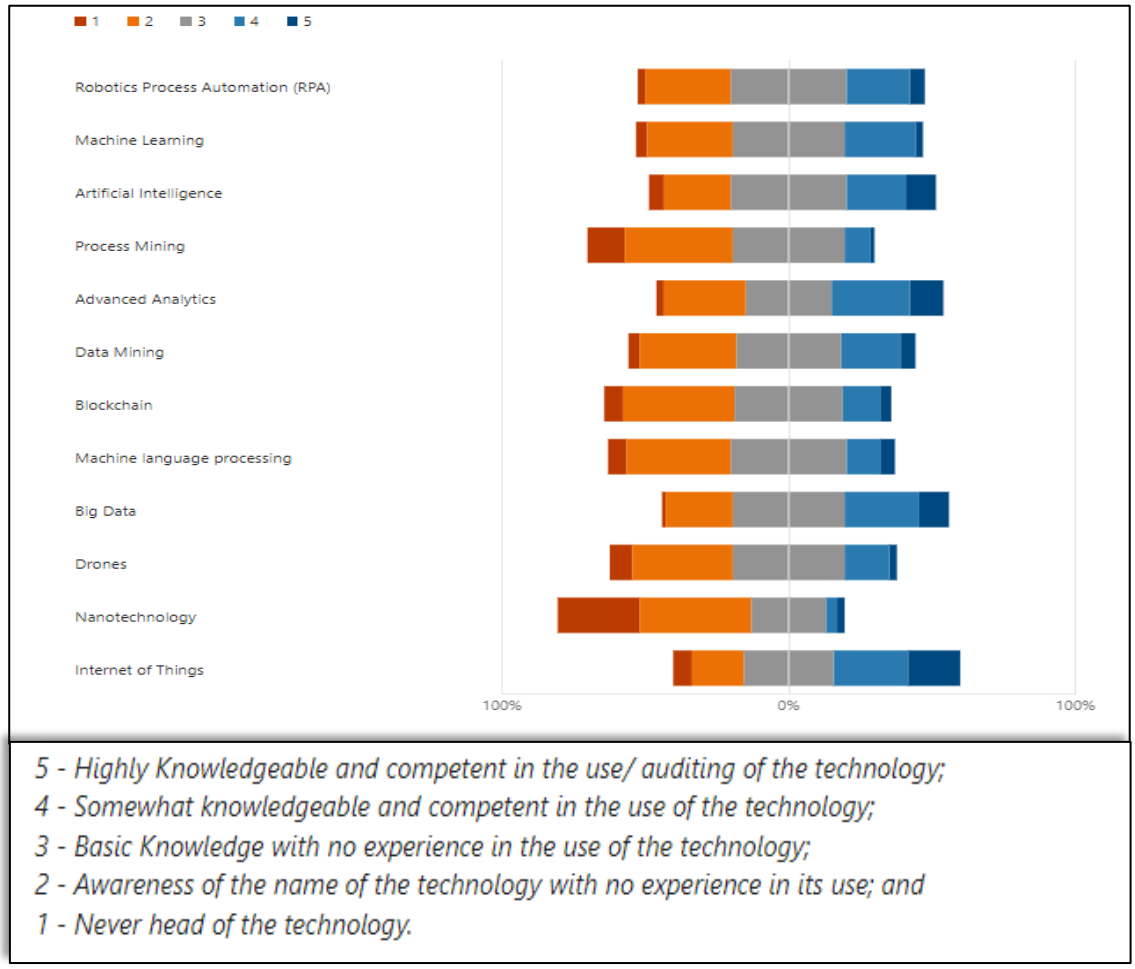



*Figure 5.3 Technical Skill and Competency Proficiency in the Adopted Technologies*

Figure 5.3 underscores a notable deficit in highly knowledgeable and competent IT audit professionals' expertise in the 12 technologies under investigation. Among these, the highest proficiency was observed in the application of the Internet of Things, with just 18.2% of respondents demonstrating high competence. Over 30% of respondents displayed awareness of Process Mining (37.7%), Data Mining (33.8%), Blockchain (39%), Machine Language Processing (36.4%), Drones (35.1%), and Nanotechnology (39%). However, these individuals lacked practical skills or competencies in using these technologies.

Most respondents indicated a basic knowledge of all the technologies under investigation, yet they still lacked experience in their utilisation. The lowest proficiency in this category was observed with Nanotechnology, with only 26% of respondents. In contrast, the highest proficiency was noted in Robotics Process Automation (RPA),

Artificial Intelligence (AI), and Machine Language Processing, with 43.1% of respondents indicating basic knowledge but no practical experience.

Of concern is the fact that IT audit professionals also reported a basic level of knowledge and competency in the use of Advanced Analytics (29.9%), Big Data (39%), Data Mining (36.4%), and Blockchain (37.7%). This is particularly troubling given the high adoption of these technologies within many organisations, especially in the financial services sector. When auditors lack proficiency in these technologies, questions arise about their capacity to deliver high-quality IT audit assurance to clients in this evolving technological landscape.

In the context of answering the research question of whether there is an alignment between the skills and competencies that IT auditors possess and the skills and competencies required by technologically advanced organisations, a thorough examination of the skills and competencies possessed by IT audit professionals in the financial services sector has revealed noteworthy alignments and disparities when compared to the skill set required for effectively navigating a rapidly advancing technological landscape.

The research findings indicate that IT audit professionals' proficiency levels reflect an average degree of competence and knowledge. This is particularly evident when considering the core competencies necessary for success in technology-driven audit environments. Alarmingly, the majority of respondents exhibited only rudimentary skills in critical areas such as accounting framework tools and techniques (63.6%), governance, risk, and control tools and techniques (62.3%), and forensic skills/fraud awareness (54.5%). Even in the case of Computer-Assisted Audit Techniques (CAATs), the proficiency level was just 49.4%, demonstrating a lack of mastery of this essential technology. These findings underscore the inadequacy of current skills in meeting the demands of the evolving technology landscape within the financial services industry.

On the positive side, our data highlights a strong proficiency among IT audit professionals in soft skills, including problem identification and solution skills (84.4%), meticulous attention to detail (88.3%), communication skills (85.7%), business acumen (80.5%), and critical thinking (89.6%). Furthermore, respondents exhibited

high competence in recognising various control types, with 81.8% demonstrating proficiency in this area.

The research also offers encouragement in the realm of technical competencies, with over 60% of respondents indicating high to expert proficiencies in areas such as IT/ICT frameworks, tools and techniques, data collection and data analysis, business process analysis, and governance, risk, and control tools and techniques. Nevertheless, the data highlights a critical need to prioritise the development of competencies related to industry regulations and standards, with only 57.1% of respondents reporting independent competence in this aspect. This is especially concerning considering the heavily regulated nature of the financial services industry and the continual evolution of regulatory frameworks in response to the adoption of new technologies by organisations in this sector.

However, the research data reveals alignment disparities when examining IT audit professionals' proficiency levels in adopting and utilising emerging technologies. Notably, the skill levels of IT audit professionals in the 12 technologies investigated, such as the Internet of Things, Process Mining, Data Mining, Blockchain, Machine Language Processing, Drones, and Nanotechnology, are far from optimal. These professionals exhibited high awareness but lacked practical competence in applying these technologies effectively.

Moreover, a concerning lack of awareness and competence was identified with regard to the adoption of nanotechnology, Robotics Process Automation (RPA), Process Mining, drones, blockchain, and natural language processing (NLP) within the audit departments.

In conclusion, the research delineates disparities in the skill set of IT audit professionals in the financial services sector concerning the evolving technological landscape. While they demonstrate strong soft skills and competence in certain technical areas, there is a notable deficiency in proficiency in emerging and critical technologies. This gap poses significant challenges for IT auditors as they seek to provide high-quality audit assurance in a financial services sector rapidly integrating advanced technologies. Addressing these disparities and enhancing competencies in

technology adoption is a pressing imperative for IT audit professionals to remain effective and relevant despite ongoing technological advancements.

### 5.4.7 Training provided to enable it audit professionals to have the prerequisite skills and competencies required to deliver quality audits.

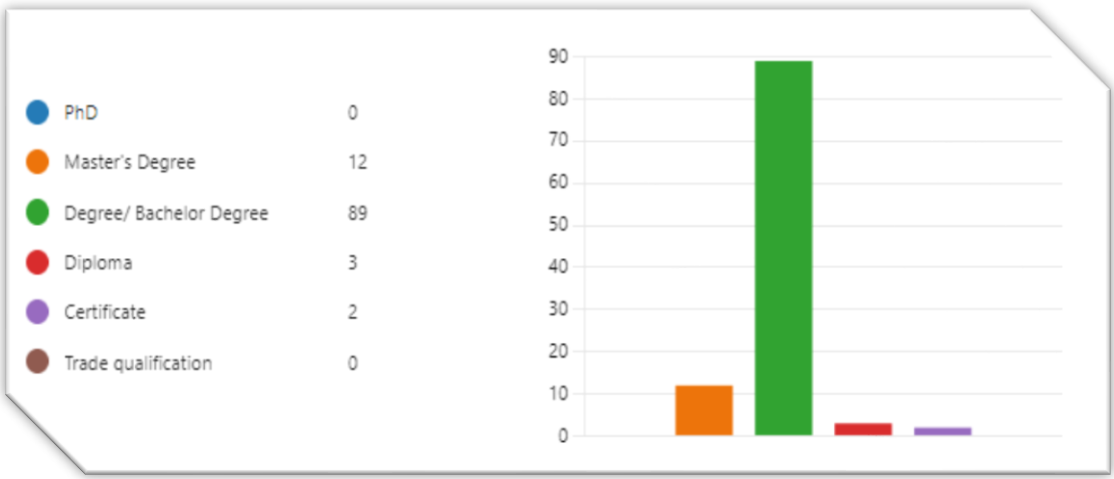



*Figure 5.4 Highest Academic Qualification*


*Figure 5.5 Possess A Professional Certification/Designation*

The study surveyed 73 respondents with certifications or designations, with the Certified Information Systems Auditor (CISA) designation being the most prevalent. Some respondents also reported having multiple designations.

Additionally, 95% of the survey's respondents mentioned that their employers offer opportunities for continuous learning. Of these opportunities, 83.6% involved in-house training, 54.8% were associated with study loans, and 47.9% were tied to student loans. While these findings highlight the proactive approach of organisations in providing avenues for IT audit professionals to acquire essential skills and competencies, it is noteworthy that most of these opportunities are in-house. Considering the pronounced disparities in skill sets and proficiencies in emerging and critical technologies uncovered by the study, one may conclude that these internal efforts alone are insufficient to bridge the existing gap. This discrepancy may stem from the rapid pace at which technology evolves, necessitating learning at an equivalent pace, or the possibility that the internal trainers lack the necessary competence to deliver training on these advanced subjects.

## 5.5 Implications Of The Study

In this section, a framework is proposed that can assist in aligning the skills and competencies of IT audit professionals within the financial services sector in South Africa.

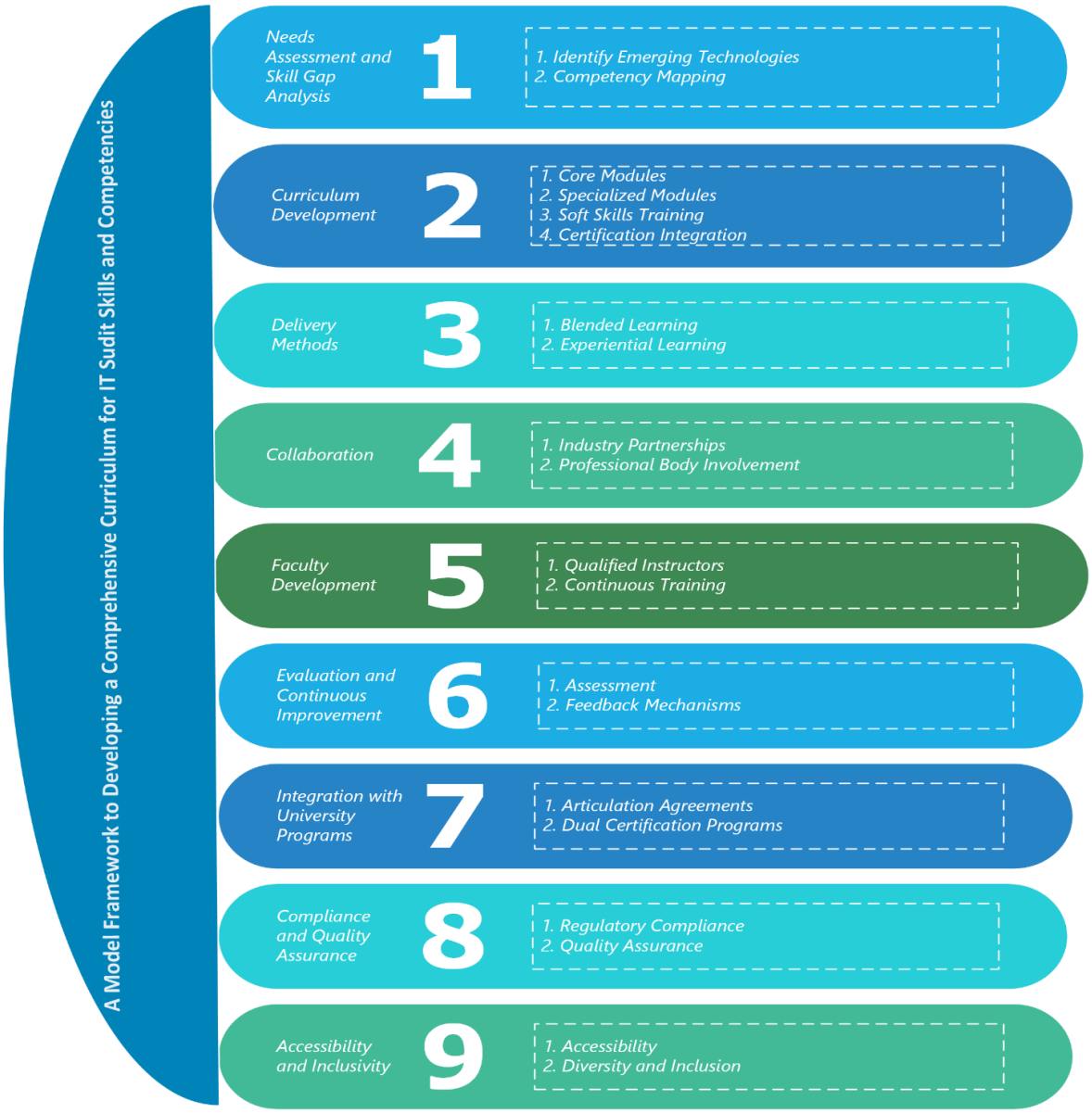



*Figure 5.6 Model Framework for IT Audit Skills and Competency Curriculum Development*

It is essential to develop a comprehensive curriculum to help organisations within the financial services sector offer effective learning and training opportunities to IT audit professionals in emerging and pivotal technologies. This model considers various stakeholders, including professional bodies offering designation qualifications and universities providing degrees in IT auditing. Here is a proposed model for such a curriculum:

### 5.5.1 Needs Assessment and Skill Gap Analysis:

- ***Identify Emerging Technologies:*** Begin by thoroughly analysing the emerging and pivotal technologies relevant to IT audit in the financial services sector. This step involves tracking industry trends, consulting with experts, and understanding organisational needs.

- ***Competency Mapping:*** Define the specific skills and competencies required for IT audit professionals to utilise these technologies effectively. This should include both technical and soft skills.

### 5.5.2 Curriculum Development:

- ***Core Modules:*** Create core modules that cover the fundamental aspects of IT auditing. These should include traditional auditing principles, regulatory requirements, and foundational IT concepts.

- ***Specialised Modules:*** Develop specialised modules for emerging technologies, such as blockchain, artificial intelligence, data analytics, and cybersecurity. Each module should focus on both theoretical knowledge and practical application.

- ***Soft Skills Training:*** Incorporate soft skills training into the curriculum, emphasising communication, critical thinking, and problem-solving, as these are essential for IT auditors.

- ***Certification Integration:*** Collaborate with relevant professional bodies (e.g., ISACA for CISA) to integrate their certification requirements into the curriculum. Ensure that the curriculum aligns with the knowledge areas assessed in these certifications.

### 5.5.3 Delivery Methods:

- ***Blended Learning:*** Utilise a blended learning approach that combines in-person, online, and on-the-job training. Offer flexibility to accommodate the needs of working professionals.

- ***Experiential Learning:*** Incorporate practical exercises, case studies, and real-world audits. Encourage participants to apply their knowledge in a controlled environment.

### 5.5.4 Collaboration:

- ***Industry Partnerships:*** Establish partnerships with financial institutions and auditing firms to provide access to real-world projects and expertise. These partnerships can also help in curriculum validation.

- ***Professional Body Involvement:*** Collaborate with professional bodies to ensure the curriculum meets their certification requirements. This partnership can also facilitate access to certification exams and resources.

### 5.5.5 Faculty Development:

- ***Qualified Instructors:*** Ensure that the curriculum is delivered by experienced instructors who are knowledgeable in IT auditing and emerging technologies.

- ***Continuous Training:*** Provide ongoing training for instructors to keep them updated with the latest industry developments.

### 5.5.6 Evaluation and Continuous Improvement:

- ***Assessment:*** Implement regular assessments to measure participants' progress and adapt the curriculum accordingly.
- ***Feedback Mechanisms:*** Establish feedback mechanisms for continuously improving the curriculum for participants, instructors, and industry partners.

### 5.5.7 Integration with University Programs:

- ***Articulation Agreements:*** Develop articulation agreements with universities offering IT auditing degrees to allow credit transfer and a seamless educational pathway.
- ***Dual Certification Programs:*** Collaborate with universities to create dual certification programs where students can earn a degree and a relevant professional certification.

### 5.5.8 Compliance and Quality Assurance:

- ***Regulatory Compliance:*** Ensure that the curriculum complies with industry regulations and standards.
- ***Quality Assurance:*** Establish quality assurance measures to maintain the curriculum's effectiveness and relevance.

### 5.5.9 Accessibility and Inclusivity:

- ***Accessibility:*** Provide accessibility options, such as online learning, to reach a wider audience of IT audit professionals.
- ***Diversity and Inclusion:*** Promote diversity and inclusion in the curriculum to ensure representation from various backgrounds and perspectives.

By implementing this model, organisations within the financial services sector can equip their IT audit professionals with the skills and competencies required to navigate the evolving technological landscape effectively. Collaboration with professional bodies and universities enhances the credibility and relevance of the training, ultimately benefiting both the professionals and the organisations they serve.

## 5.6 Recommendations for Further Research

This research contributes to our understanding that there are significant disparities within IT audit professionals' current skill set and expertise compared to the skill set and expertise required in a technologically advanced landscape. As well as suggesting a framework that can assist in bridging the gap, several areas remain for further investigation and research. These include:

*Effectiveness of Curriculum Implementation*: Future research can assess how well organisations and educational institutions implement the proposed curriculum framework and whether it effectively addresses competency gaps. This can involve case studies and longitudinal studies tracking the impact of curriculum changes.

*Impact on Audit Quality*: Research can delve deeper into the correlation between enhanced IT audit skills and the quality of audit work. This involves evaluating whether IT audit professionals who undergo the recommended training deliver higher-quality audit services and contribute more effectively to internal control environments.

*Alignment with Emerging Technologies*: The rapid pace of technological advancement necessitates continuous adaptation. Future research can explore how well the proposed curriculum framework adapts to new emerging technologies and whether it can keep IT audit professionals up-to-date in a dynamic tech landscape.

*Long-Term Career Outcomes*: Investigate how the proposed training initiatives affect the long-term career outcomes of IT audit professionals. This could involve tracking career progression, job satisfaction, and staying relevant in a technology-driven profession.

*Impact on Organisational Resilience*: Explore how organisations' resilience and adaptability to technological disruptions are influenced by the proficiency of their IT audit professionals. This research could examine whether organisations with well-trained IT audit teams are better equipped to navigate technological changes and mitigate risks.

## 5.7 Conclusion

The research yields valuable insights into examining the alignment and disparities in IT audit professionals' skill sets concerning the rapidly evolving technological landscape in the financial services sector. While IT audit professionals exhibit robust soft skills and competence in specific technical domains, there exists a significant deficiency in proficiency when it comes to emerging and pivotal technologies. This gap poses a pressing challenge as IT auditors strive to offer high-quality audit assurance in a financial sector that is continually integrating advanced technologies.

Moreover, the study highlights the proactive stance of many organisations in providing avenues for their IT audit professionals to acquire essential skills and competencies. However, most of these opportunities take the form of in-house training. Given the disparities in skill sets uncovered in this research, it becomes evident that internal efforts alone are insufficient to bridge the gap. This disparity may arise from the rapid pace of technological advancement, necessitating corresponding swift learning, or from a potential lack of competence among internal trainers to deliver education on these advanced subjects.

In light of these findings, addressing these disparities and enhancing competencies in technology adoption becomes imperative for IT audit professionals in the financial services sector. This effort is essential to ensure they remain effective and relevant in an environment where technology is continually advancing and high-quality audit assurance is paramount.

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## APPENDICES

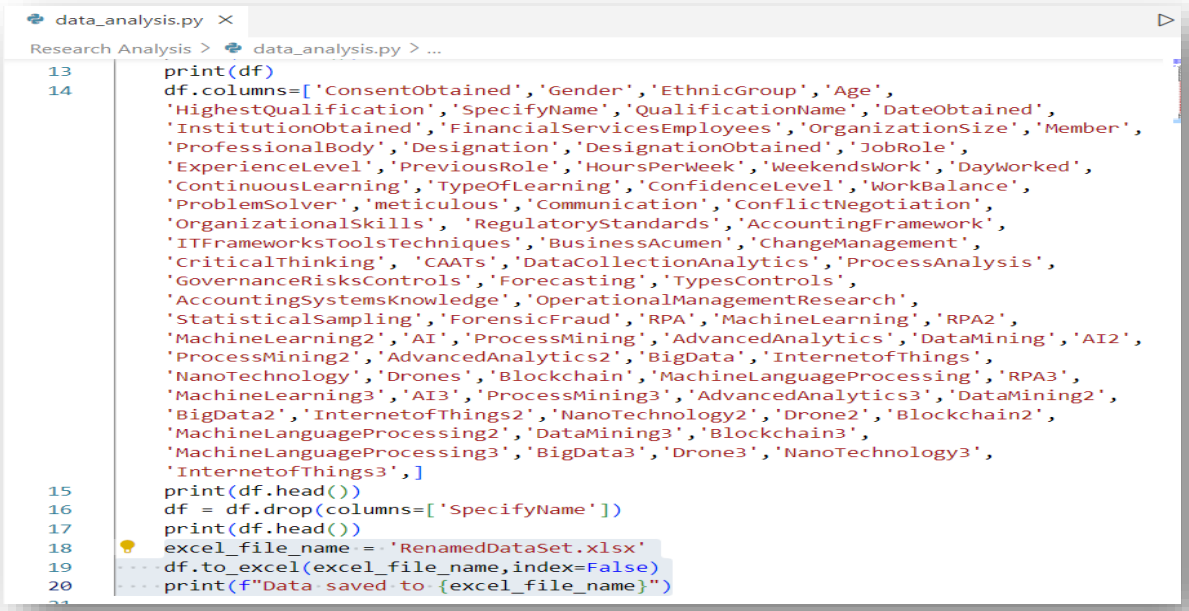
### *Appendix A Python Code Used for Data Preparation*

#### *A.1: Remove Blanks Python Code*

```python
import pandas as pd
import numpy as np
import openpyxl

if __name__ == '__main__':
    file_path ='Dataset.xlsx'
    df= pd.read_excel(file_path)
    print(df.head())
    df = df.drop(columns=['ID', 'Start time', 'Completion time', 'Email', 'Name'])
    print(df.head())
    blank_columns = df.columns[df.isnull().all()]
    print(df.head())
```

#### *A.2: Rename Columns Python Code*



```python
    print(df)
    df.columns=['ConsentObtained','Gender','EthnicGroup','Age',
    'HighestQualification','SpecifyName','QualificationName','DateObtained',
    'InstitutionObtained','FinancialServicesEmployees','OrganizationSize','Member',
    'ProfessionalBody','Designation','DesignationObtained','JobRole',
    'ExperienceLevel','PreviousRole','HoursPerWeek','WeekendsWork','DayWorked',
    'ContinuousLearning','TypeOfLearning','ConfidenceLevel','WorkBalance',
    'ProblemSolver','meticulous','Communication','ConflictNegotiation',
    'OrganizationalSkills', 'RegulatoryStandards','AccountingFramework',
    'ITFrameworksToolsTechniques','BusinessAcumen','ChangeManagement',
    'CriticalThinking', 'CAATs','DataCollectionAnalytics','ProcessAnalysis',
    'GovernanceRisksControls','Forecasting','TypesControls',
    'AccountingSystemsKnowledge','OperationalManagementResearch',
    'StatisticalSampling','ForensicFraud','RPA','MachineLearning','RPA2',
    'MachineLearning2','AI','ProcessMining','AdvancedAnalytics','DataMining','AI2',
    'ProcessMining2','AdvancedAnalytics2','BigData','InternetofThings',
    'NanoTechnology','Drones','Blockchain','MachineLanguageProcessing','RPA3',
    'MachineLearning3','AI3','ProcessMining3','AdvancedAnalytics3','DataMining2',
    'BigData2','InternetofThings2','NanoTechnology2','Drone2','Blockchain2',
    'MachineLanguageProcessing2','DataMining3','Blockchain3',
    'MachineLanguageProcessing3','BigData3','Drone3','NanoTechnology3',
    'InternetofThings3',]
    print(df.head())
    df = df.drop(columns=['SpecifyName'])
    print(df.head())
    excel_file_name = 'RenamedDataSet.xlsx'
    df.to_excel(excel_file_name,index=False)
    print(f"Data saved to {excel_file_name}")
```

*A.3: Filter to 'FinancialServicesEmployees'= 'Yes' Python Code*

data_analysis.py | FinancialServices.py

Research Analysis > FinancialServices.py > ...

```python
from logging import Filterer
import pandas as pd

if __name__ == '__main__':
    file_path ='RenamedDataSet.xlsx'
    df= pd.read_excel(file_path)
    print(df.head())

# filter to only the data for employees within financial services

FinancialServices_df =df[df['FinancialServicesEmployees']=='Yes']
print(FinancialServices_df.head())
# Save output into an excel file named FinancialServices

SaveToexcel = 'FinancialServicesDataSet.xlsx'
FinancialServices_df.to_excel(SaveToexcel,index=False)
print(f"Data saved to {SaveToexcel}")
```

## *A.4: Upskilling Opportunities Graph Code*

Research Analysis > firstplot.py > ...

```python
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np

# Assumed the DataFrame is named FinancialServicesData
file_path = 'FinancialServicesData.xlsx'
df = pd.read_excel(file_path)
print(df.head())

# Filtered the DataFrame based on conditions
filtered_df = df[(df['ContinousLearning'] == 'Yes')]

# Calculated the percentages of "Yes" values in each column
total_rows = filtered_df.shape[0]
percent_bursary = (filtered_df['Bursary'].eq('Yes').sum() / total_rows) * 100
percent_study_loans = (filtered_df['Study Loans'].eq('Yes').sum() / total_rows) * 100
percent_inhouse_training = (filtered_df['InHouseTraining'].eq('Yes').sum() / total_rows) * 100

# Created a bar graph
categories = ['Bursary', 'Student Loans', 'InHouse Training']
percentages = [percent_bursary, percent_study_loans, percent_inhouse_training]

plt.bar(categories, percentages, color=['blue', 'green', 'purple'])
plt.xlabel('Type of Learning Support Offered')
plt.ylabel('Percentage')
plt.title('Upskilling Opportunities (ContinuousLearning = Yes)')
plt.ylim(0, 100)  # Set y-axis limits to 0 and 100

# Labeled the percentages on the bars
for i, percentage in enumerate(percentages):
    plt.text(i, percentage + 2, f'{percentage:.1f}%', ha='center', va='bottom', color='black')

plt.show()

```

***Appendix B Consent Form***

Cape Peninsula University of Technology

**Department of Internal Auditing & Financial Information Systems**
**Ethics informed consent form**

**CONSENT TO PARTICIPATE IN A RESEARCH STUDY**

The importance of time in our days cannot be overemphasized. At the same time, sharing your time with someone can be very enriching, rewarding and fulfilling. You are kindly invited to participate in a research study being conducted by **Siviwe P. Tyaliti** (student number 21706856) from the Cape Peninsula University of Technology.

I would like to introduce my research to you. I am currently working on a Masters Research project in the field of Internal Auditing under the School of Accounting Sciences at the Cape Peninsula University of Technology. I am seeking your participation, to share approximately 10-15 minutes of your valuable time to conduct an online questionnaire-based interview. Granted, such permission will enable me to carry out surveys within the internal auditing/ compliance space.

The title of my research project is '**Challenges of Rapid Technology Advancement on IT Audit Skills and Competencies in South Africa**'. The main objective is to guide implementation and monitoring of IT Audit Skills and Competencies in South Africa, with the aim of enhancing effectiveness and value-addition within IT audit operations.

Furthermore, due to the Covid-19 pandemic a note should be taken that this letter only seeks permission for data to be collected using an online survey.

The researchers pledge, that all the survey data will be aggregated and organisational information will be treated with the strictest confidence; and that you are under no obligation to participate. All the information obtained will be used for research thesis and research publication purposes only. The final report will not include any identifying information of your organisation. Please feel free to contact student and/or supervisor with regards to any queries you might have. Your participation in the research project will be most appreciated.

**Category of Participants (tick as appropriate):**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Internal Auditor* | | *Accountant* | | *Compliance Officer* | | *Risk Officer* | | *Manager/Director* | |
| *Other (specify)* | | | | | | | | | |

**Please sign the consent form. You will be given a copy of this form on request.**

| | |
|---|---|
| | Date and stamp: |
| Signature of participant | |

| | |
|---|---|
| **Researcher's** Name: | Tel: |
| | Email: |
| **Supervisor:** | |
| Contact number: | Email: |

## *Appendix C Letter of Permission*

Roodebloem Office Park
20 Bella Rosa Street
Bellville
Cape Town
7535

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Midrand
Johannesburg
2090

**ISACA SA Research Assistance Programme**

**Purpose:**

The purpose of the programme is to provide students who are in their final year or pursuing post graduate studies in areas where there is potential to advance the Chapter's programmes with access to a database of potential research participants, thus not only helping the students to advance their studies, but also contributing to the creation of knowledge. Applicants for Research Assistance must note that members of ISACA SA to whom we will direct the survey tools are encouraged to, but do not have an obligation to participate in the research assistance program.

*Students interested in applying for Research Assistance support must complete this application form and submit supporting information requirements as noted below to* ***academic.relations@isaca.org.za*** *and* ***info@isaca.org.za***

**Rules**

1. Ethical Clearance form from the University at which the student is enrolled (survey will not be sent to our members without the ethical clearance).
2. Preference will be given to students pursuing the fields of Information Systems (IS), Cybersecurity, IT Governance, IT Audit, IT Risk Management, Information Security, Information Technology, Internal Audit, Accounting, Financial Information Systems or other related studies.
3. All Applicants must be registered for the relevant academic year in respect of University students (proof of registration required)
4. Students who submit a recommendation letter from their University, a member of ISACA, their mentor, or another professional body will be given preference

***NB: ISACA SA may at its discretion offer a letter of support to facilitate issuance of an ethical clearance by the University where required, but the survey tool will only be sent to the research participants in our database once such ethical clearance has been received by ISACA SA. Such letter of support will only be granted after this application form has been duly completed.***

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## Section 1 – Administrative Information

| | |
|---|---|
| Name(s) & Surname: | Siviwe Prudence Tyaliti |
| University Name | Cape Peninsula University of Technology |
| Field of Study & Expected Date of completion | Master in Internal Auditing (Expected date of completion : December 2022) |
| Home or Campus Address: (optional) | |
| Postal Address: | 15914 Mpinga Square Nyanga<br>7750 |
| Home or Campus Phone: | 0216503266 |
| Cell Phone Number: | 0788547019 |
| Email Address: | s.p.tyaliti@gmail.com |

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## Section 2 – Activities and Interests

A. List and briefly describe *volunteer* activities in which you have been involved:

| Organisation Name | Position Held (Dates) | Description |
|---|---|---|
| SAFA Cape Town | Regional Committee Member | Committee member for the SAFA Cape Town region and also a member of the Women's department committee and Internal Audit commitee within the organization. |
| ANC Youth League ward 37 committee member | Committee Member | Committee member for the Youth League in my ward charged with programs for youth empowerment and up-liftment as well as to encourage youth to engage in the country's politics via the ward. |
| Ikamva Ladies football club | Secretary and administrator of the club | Handle administration responsibilities of the club such as club registrations, competitions registrations, player affairs and attend all meetings where the club is required in attendance. Responsible for the club's communications and correspondence. |

B. List *honours* or *academic awards* you have received (e.g. scholarly activities, research, etc.):

| Award/Honor | Institution/Organisation | Date(s) |
|---|---|---|
| | | |
| | | |
| | | |

C. List and briefly describe your *extracurricular* activities if any (e.g. memberships in Organisations, sports, etc.):

| Organisation Name | Dates | Description (including positions held as applicable) |
|---|---|---|
| Ikamva Ladies football club | Since 2009 | Was a captain for five seasons and helped ensured the team got promoted to the Sasol league which was the |

| | | |
|---|---|---|
| | | highest league for Women in South Africa at the time. I then moved to an administrative role within the team while also still playing in 2016. |
| CPUT Womens USSA team | 2021 | Selected to the part of the Ladies team that will represent CPUT on the USSA tournament taking place in December 2021. |
| | | |

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## Section 3 – Research Topic (Limit your responses to no more than half a page – you may use this form and the text boxes below to answer)

A. Indicate your research topic in the space provided and include a brief summary of the research problem you are trying to solve, or why you are pursuing a research in this area?

Research topic: Challenges of Rapid Technology Advancement on IT Audit Skills and Competencies within Financial Services Sector in Cape Town.

Technological advancements have caused an evolving risk landscape, which now necessitates an evolving internal controls environments. Risk management strategies, processes and frameworks need to align with these technological advancements (Schutte and Marx, 2018). This has resulted in Internal Auditors needing technical skills and new competencies in order to perform their Mandate and continue being effective and relevant to organizations (Anderson, 2020; 20). When looking at the Johari Window Model paradigm of Known Unknowns explained by the former US Secretary of State Donald Rumsfeld as "Things we know that we don't know" (Lyons, 2020), there are things that Internal Auditors know they do not know. This includes being aware that there is technical knowledge and competencies that they do not currently have but will need to continue being effective.

Auditor IT knowledge and competencies, and Internal Control knowledge have been proven to have a correlation to the quality of Audit work (Siew, et al, 2017). These skills and competencies are required by all Internal Audit professionals around the globe depending on the level of Technology adoption maturity of the different organizations that they service. (Marx and Roujee, 2015; 102) also agree that the rapid technological advancements by organizations have an influence on the quality of audit work. It is important to understand whether IT auditors in South Africa are continuously upskilling themselves with these skills to ensure the effectiveness and relevance of the IT audit function.

The study seeks to prove by applying the methodological assumptions of positivism in employing a descriptive quantitative approach the hypothesis that rapid technological advancements has created a misalignment of skills and competencies of IT auditors in South Africa.

## Section 4 – Consent to publish results of Research

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B. Indicate by answering **yes** or **no** in the box below whether you give ISACA SA at its discretion, permission to publish the results of your research through its website, social media pages or any other platform

*NB: This information will not be used against applicants but ISACA would be better able to fulfil the objective of facilitating knowledge creation if we can optionally publish some of the research results where necessary.*

*ISACA SA Will also notify the relevant authors of such intention to publish before doing so at the relevant time.*

| |
|---|
| Yes |

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## Section 5 – Communication of outcome of application

Applications for Research Assistance shall be approved by the Academic Relations and Education Committee and its decision regarding whether or not to support the application shall be considered final. Applicants should allow a turnaround of a maximum of two weeks to receive feedback on their applications (i.e. within 1-14 days).

21/09/2021

**Signature of Applicant** **Date**

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## Section 6 – Research Assistance Application supporting documents

- ☐ Application form
- ☐ Ethical Clearance (*required to send survey to participants. Where student requires letter of support to facilitate obtaining a letter of clearance, this requirements will be optional at that stage*)
- ☐ Proof of registration at a recognised Tertiary Institution for the relevant academic year
- ☐ Proof that the student is pursuing a field of study that supports a career in Information Systems (IS), Cybersecurity, IT Governance, IT Audit, IT Risk Management, Information Security, Information Technology, Internal Audit, Accounting, Financial Information Systems or other related studies (can be deduced from proof of registration)
- ☐ Recommendation letter from University or ISACA member or professional body or mentor (an added advantage)

* * * * * * * * * *

The Research Assistance support application form and supporting documentation must be submitted electronically to academic.relations@isaca.org.za and info@isaca.org.za

## *Appendix D Ethics Clearance*

Cape Peninsula University of Technology

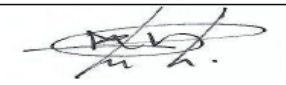
P.O. Box 1906 | Bellville 7535
Symphony Road Bellville 7535
South Africa
Tel: +27 21 4603291
Email: fbmsethics@cput.ac.za

| Office of the Chairperson<br>Research Ethics Committee | **FACULTY: BUSINESS AND MANAGEMENT SCIENCES** |
|---|---|

The Faculty's Research Ethics Committee (FREC) on **16 November 2021**, ethics **APPROVAL** was granted to **Siviwe P. Tyaliti (213179393)** for a research activity for **Master of Internal Auditing** at the Cape Peninsula University of Technology.

| **Title of project:** | **Effect of Rapid Technology Advancement on IT audit skills and competencies within the Financial Services Sector in South Africa**<br><br>Researcher (s): Prof J Dubihlela |
|---|---|

**Decision:** APPROVED

|  | **22 November 2021** |
|---|---|
| **Signed: Chairperson: Research Ethics Committee** | **Date** |

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the CPUT Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study requires that the researcher stops the study and immediately informs the chairperson of the relevant Faculty Ethics Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines, and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, notably compliance with the Bill of Rights as provided for in the Constitution of the Republic of South Africa, 1996 (the Constitution) and where applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003 and/or other legislations that is relevant.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
7. No field work activities may continue after two (2) years for Masters and Doctorate research project from the date of issue of the Ethics Certificate. Submission of a completed research ethics progress report (REC 6) will constitute an application for renewal of Ethics Research Committee approval.

**Clearance Certificate No | 2021_FBMSREC 088**

## *Appendix E Questionnaire*




# Effects of Rapid Technology Advancement on IT audit Skills and Competencies

Dear Respondent,

**Invitation to participate in an academic research study**

My name is Siviwe Prudence Tyaliti and I am currently studying towards a Master's Degree in Internal Auditing with the Cape Peninsula University of Technology, in Cape Town. My research topic is "**Effects of Rapid Technology Advancement on IT audit Skills and Competencies within the Financial Services Sector in South Africa.**" I kindly request your assistance in completing this questionnaire based on your knowledge and experience in IT Audit assurance, IT risks, IT controls, IT governance as well as consulting services. Completing this questionnaire will take approximately 10 minutes. The responses obtained from this study will contribute towards providing guidance on implementation and monitoring of IT audit Skills and Competencies in South Africa in order to enhance effectiveness and value-add within the IT audit operations.

The responses obtained in this study will be kept confidential and will only be used for research purposes only, including publication in academic journals. The final report, and any other articles developed from the responses obtained, will not include any information identifying the respondents. The name and email address captured on completion of this form will be kept anonymous in aggregated data. Should you have any enquiries, please feel free to contact; me at 0788547019 or my supervisor Prof J. Dubihlela on email: dubihlelaj@cput.ac.za

* Required

1. If you consent to participate in this research survey, kindly tick the "Yes" button, otherwise select "No"

   Selecting the "Yes" button, you also agree to have read and understood the information provided above and you were afforded the opportunity to ask questions. *

   - ◯ Yes
   - ◯ No

2. Please Select your Gender *

   - ◯ Male
   - ◯ Female
   - ◯ Non-binary
   - ◯ Prefer not to say

3. What is your Ethnic group?

- ◯ Black
- ◯ Coloured
- ◯ Indian
- ◯ White
- ◯ African

4. Please select your Age group *

- ◯ 20-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60+

5. What is your Highest academic qualification? *

- ◯ PhD
- ◯ Master's Degree
- ◯ Degree/ Bachelor Degree
- ◯ Diploma
- ◯ Certificate
- ◯ Trade qualification

6. Please specify name of trade qualification *

7. Please specify name of qualification (e.g Bachelor of commerce) *

8. When did you obtain the qualification? *

9. Which institution did you obtain the qualification? *

10. Are you currently working in the Financial Services/ Insurance Sector? ( this includes auditing clients in the Financial Services/ Insurance Sector) *

- ◯ Yes
- ◯ No

11. What is the staff complement in the organization in which you are employed? *

- ◯ 1-50
- ◯ 51-100
- ◯ 101-150
- ◯ 151-200
- ◯ >200

12. Do you belong to a professional body? *

- ◯ Yes
- ◯ No

13. Kindly indicate which body you are a member of. *

14. Do you possess any certification/designations issued by a professional body? *

- ◯ Yes
- ◯ No

15. Please list all certifications/designations obtained and when they were obtained *

16. Specify the most appropriate description for your current job role. *

- ◯ IT audit Intern
- ◯ IT audit analyst
- ◯ IT auditor
- ◯ IT Risk
- ◯ IT Governance
- ◯ It Consulting Services
- ◯ IT controls implementation

17. Specify the level of experience that best describes your current role *

- ◯ Newly appointed (less than a year)
- ◯ Experienced
- ◯ Specialist
- ◯ Supervisor/Manager
- ◯ Executive

18. Specify the job role you occupied in your previous company or before your promotion *

19. How many hours a week do you work? *

20. Do you work weekends? *

- ◯ Yes
- ◯ No
- ◯ Sometimes

21. Please select the day of the weekend you mostly work *

- ◯ Saturday
- ◯ Sunday
- ◯ Both Saturday and Sunday

22. Does your company provide opportunities for continuous learning? e.g. bursaries, study loans, inhouse training? *

- ◯ Yes
- ◯ No

23. Please select all continuous learning opportunities provided by your organisation *

- ☐ Bursary
- ☐ Study loans
- ☐ In-house training

## Part 2: Acquired audit skills and competencies

**Please respond to the following statements in relation to the skills and competencies that you have acquired in the recent years in your profession.**

*for each of the following statements, kindly indicate the level of your experience for each statement using the suggested scale:*
*5 - Independently competent in unique and complex situations;*
*4 - Independently competent in routine situations;*
*3 - Basic competence and knowledge with support from others;*
*2 - 2; and*
*1 - Not competent or knowledgeable*

24. Self-motivation, determination and confidence *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

25. Ability to divide your time between work and continual professional development *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

26. Problem identification and solution skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

27. meticulous attention to detail *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

28. Communication skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

29. Conflict resolution/negotiation skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

30. Organizational skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

31. Industry regulatory and standards changes *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

32. Accounting framework tools and techniques *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

33. IT/ICT Frameworks, tools and techniques *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

34. Business acumen *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

35. Change Management skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

36. Critical thinking skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

37. Use of CAAT (Computer-assisted auditing tools) *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

38. Data collection and data analytics *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

39. Business process analysis *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

40. Governance, risk, and control tools and techniques *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

41. Forecasting skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

42. Identifying types of controls *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

43. IT and accounting system knowledge *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

44. Operational and management research skills *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

45. Statistical sampling *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

46. Forensic skills/ Fraud awareness *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

## Part 2: Acquired audit skills and competencies

**The following statements relate to your level of knowledge and competence with the following technologies and the level of adoption of the following technologies in your organization and department.**

47. **For each of the following statements, kindly indicate the level of your knowledge and experience for each technology using the suggested scale:**

*5 - Highly Knowledgeable and competent in the use/ auditing of the technology;*
*4 - Somewhat knowledgeable and competent in the use of the technology;*
*3 - Basic Knowledge with no experience in the use of the technology;*
*2 - Awareness of the name of the technology with no experience in its use; and*
*1 - Never head of the technology.*

*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Robotics Process Automation (RPA) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Machine Learning | ◯ | ◯ | ◯ | ◯ | ◯ |
| Artificial Intelligence | ◯ | ◯ | ◯ | ◯ | ◯ |
| Process Mining | ◯ | ◯ | ◯ | ◯ | ◯ |
| Advanced Analytics | ◯ | ◯ | ◯ | ◯ | ◯ |
| Data Mining | ◯ | ◯ | ◯ | ◯ | ◯ |
| Blockchain | ◯ | ◯ | ◯ | ◯ | ◯ |
| Machine language processing | ◯ | ◯ | ◯ | ◯ | ◯ |
| Big Data | ◯ | ◯ | ◯ | ◯ | ◯ |
| Drones | ◯ | ◯ | ◯ | ◯ | ◯ |
| Nanotechnology | ◯ | ◯ | ◯ | ◯ | ◯ |
| Internet of Things | ◯ | ◯ | ◯ | ◯ | ◯ |

48. **for each of the following statements, kindly indicate the level of your organizations' adoption for each statement using the suggested scale:**
*5 - Fully adopted in all areas/ departments of the organization;*
*4 - Adopted in some areas/departments of the organization with implementation plans for the rest of the departments underway;*
*3 - Technology still in research and development phase in the organization;*
*2 - Technology not yet implemented on the organization; and*
*1 - Not aware of the technology being adopted.* *

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Robotics Process Automation (RPA) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Machine Learning | ◯ | ◯ | ◯ | ◯ | ◯ |
| Artificial Intelligence | ◯ | ◯ | ◯ | ◯ | ◯ |
| Process Mining | ◯ | ◯ | ◯ | ◯ | ◯ |
| Advanced Analytics | ◯ | ◯ | ◯ | ◯ | ◯ |
| Data Mining | ◯ | ◯ | ◯ | ◯ | ◯ |
| Big Data | ◯ | ◯ | ◯ | ◯ | ◯ |
| Internet of Things | ◯ | ◯ | ◯ | ◯ | ◯ |
| Nanotechnology | ◯ | ◯ | ◯ | ◯ | ◯ |
| Drones | ◯ | ◯ | ◯ | ◯ | ◯ |
| Blockchain | ◯ | ◯ | ◯ | ◯ | ◯ |
| Machine Language processing | ◯ | ◯ | ◯ | ◯ | ◯ |

49. **For each of the following statements, kindly indicate the level of adoption for each statement using the suggested scale:**

*5 - Fully adopted in the department;*
*4 - Adopted to some extent;*
*3 - Technology still in research and development phase in the department;*
*2 - Technology not currently used by the department; and*
*1 - Not aware of any adoption of the technology.* *

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Robotics Process Automation (RPA) | ○ | ○ | ○ | ○ | ○ |
| Machine Learning | ○ | ○ | ○ | ○ | ○ |
| Artificial Intelligence | ○ | ○ | ○ | ○ | ○ |
| Process Mining | ○ | ○ | ○ | ○ | ○ |
| Advanced Analytics | ○ | ○ | ○ | ○ | ○ |
| Data Mining | ○ | ○ | ○ | ○ | ○ |
| Big Data | ○ | ○ | ○ | ○ | ○ |
| Internet of Things | ○ | ○ | ○ | ○ | ○ |
| Nanotechnology | ○ | ○ | ○ | ○ | ○ |
| Drones | ○ | ○ | ○ | ○ | ○ |
| Blockchain | ○ | ○ | ○ | ○ | ○ |
| Machine Language Processing | ○ | ○ | ○ | ○ | ○ |

## *Appendix F Data Management Plan*

# Effect of Rapid Technology Advancement on IT audit Skills and Competencies within the Financial Services Sector in South Africa. - Data Management Plan

## DATA COLLECTION

**What data will you collect/create?**

What type, format and volume of data?
- The data collected with be derived data collected from a survey questionnaire.
- This data will be new data collected during the course of the research.
- The questionnaire will be in a form of Googole quetionnaire/ Microsoft forms (downloaded into excel version for processing).
- The data will be from a total respondents of 100>.

**How will the data be collected or created?**

The data will be collected through a Microsoft forms survey questionnaire. Microsoft forms (Link to survey) will be sent via email, through messaging platforms such as LinkedIn.
- an email trail of each response received will be retained and saved via a folder named "Research Responses Test" in an Outlook email account (213179393@mycput.ac.za).
- All data extracted from Microsft forms will be saved on the cloud using Microsoft OneDrive Storage with account (213179393@mycput.ac.za) on the My files Folder under Folder name " Research Data".
- Vesioning control will be maintained by using a naming convension on the data files on V followed by the version number at the end of each file name.
- The data will alsobe stored in Figshare https://cput.figshare.com/.Figshare is a data repository that allows researchers to manage, store, and discover their research. This data repository contains unique features to allow researchers to describe each dataset by adding title, authors, subject categories, item type, keywords, description or abstract, funding body, license, embargo, secured by a private link or reserved DOI (Digital Object Identifier) and produce version control.

## DATA DOCUMENTATION AND METADATA

**What documentation and metadata will accompany your dataset?**

All three data repository **Figshare** https://cput.figshare.com/ , provide metadata fields to describe each dataset by adding title, author/s, subject categories, default list of keywords including options to add key words manually. There's a space to describe datasets or add abstract. Each dataset in each folder will be described using metadata fileds with each data repository.

## ETHICS AND LEGAL COMPLIANCE

**How will you manage any ethical issues pertaining to data?**

Proper ethical procedures as required by the Research Committee of the University will be followed. This includes following data policies in terms of data sharing and preservation. Using Fighshare, a private link or reserved Digital Object Identifier (DOI) will be generated for each dataset. The project leader or researcher can create a link (private link, reserved DOI) which will secure each dataset and this will allow sharing at the same time protecting the datasets between project team members.
The responses obtained in this study will be kept confidential and will only be used for research purposes only, including publication in academic journals. The final report, and any other articles developed from the responses obtained, will not include any information identifying the respondents. The name and email address captured on completion of this form will be kept anonymous in aggregated data. This will be clearly stated in the begining of the Survey and a respondent is required to select "Yes"to indicate apporoval to participant in the survey before they can continue with any questions of the survey. An Informed Consent form will be prepared and given to participants who complete a manual questionnaire (this will be in the rare instance that responses were obtained manually via a physical survey). The responses obtained in this study will be kept confidential and will only be used for research purposes only, including publication in academic journals. The final report, and any other articles developed from the responses obtained, will not include any information identifying the respondents. The name and email address captured on completion of this form

will be kept anonymous in aggregated data.
The data for the project will be managed and stored in Microsoft OneDrvie document storage where only the researcher has access as well as on (**Figshare** https://cput.figshare.com/)

**How will you manage copyright and Intellectual Property Rights (IPR) issues?**

Findings will remain the property of the University, The Researcher and any funder obtaned for the research. Our findings will be published in peer reviewed Open Access Journals. Therefore there will be no unforeseen copyright and IPR issues.

## DATA STORAGE AND BACKUP

**How will you store and back up your data during the research?**

CPUT support researchers with two data repositories including the institutional repositories. The data for this project will be saved and backed up in CPUT data repository **Figshare** at https://cput.figshare.com/ and on Microsoft OneDrive cloud storage using the CPUT Microsoft student Account which only the reseacher has access. accessible via mycputac-my.sharepoint.com/personal/

**How will you manage access and security?**

During the research process access to datasets will only be given to direct or indirect participants by assigning rights. This includes collaborators who will be given rights to read, edit and collaborate through the data repository (Figshare at https://cput.figshare.com/). This research data repository is safe and secured and will allow the team leader to implement rights management in each PROJECT folder for active dataset based on specific groups or individuals.
Using Figshare, a private link or reserved Digital Object Identifier (DOI), the project leader or reseacher will create a link which will secure each dataset and this will allow sharing at the same time protecting the datasets between project team members.

## DATA SELECTION AND PRESERVATION

**Explain which data should be retained, shared, and /or preserved?**

- Any personal Identifying data will be deleted in all data sets retained.
- Any other data will be retained in the repository for future research for up to a maximum of 3 years.

## DATA SHARING

**How will data be shared?**

Data will be shared between collaborators using "MY DATA and PROJECT" on Figshare ( https://cput.figshare.com/). This will allow the project leader/s or researchers to INVITE participants via email to view or participate in each project folder and each dataset will be protected by either private link or DOI. After publications, data will be shared using Open Access Repositories Figshare (https://cput.figshare.com/) and the Institutional Repository (http://digitalknowledge.cput.ac.za/) for public access.

**Are any restrictions on data sharing required?**

In-case there are such restrictions, the principal investigator or researcher may restrict the sharing of data within CPUT repositories (Figshare, and the Institutional repository) by giving rights (view only, read, collaborate, edit) to each participant using one of the data repositories.

## RESPONSIBILITIES AND RESOURCES

**Who will be responsible for data management?**

- The Principal Researcher and the Institution will be responsible for data management .
- Data owenrship and responsibilties for RDM will be part of the Institution and Student on the CPUT policy on Intellectual property.

**What resources will you require to deliver your plan?**

- Data Analysis software will be required which training for use of the software will be done through CPUT PG Workshops and external training via Youtube and other reputable training institutions (i.e Udemy).

## PERSONAL, SENSITIVE AND IDENTIFIABLE HUMAN RESEARCH DATA

**Will you be collecting personal information?**

Yes

**List all the types of personal/sensitive/identifiable data you will be collecting.**

(a) information relating to the race, gender, sex, age,;
(b) information relating to the education or employment history of the person;

**Conduct a benefit/risk analysis to ensure that the benefit of collecting such data outweighs the risk and then motivate why you need to collect such information.**

The personal Information obtained is minimal and can not lead a third party to identify the individual owner the information was obtained from due to the nature the information will be obtained.

**Confidentiality, anonymity, and privacy of human participants.**

The responses obtained in this study will be kept confidential and will only be used for research purposes only, including publication in academic journals. The final report, and any other articles developed from the responses obtained, will not include any information identifying the respondents. The name and email address captured on completion of this form will be kept anonymous in aggregated data.

**What happens to the information if a participant withdraws from a study?**

There is no information which will be retained should the participant answer "No" no to the consent question or fails (abandons) the survey.

**After completion of the research, will the information be used for anything else in the future?**

- Future use of the information may exist as foundations to future resaerch of building models using assumptions from the data. The data will be obtained for a maximum of 3 years at which point if it is not used for further research must be deleted.

**Will study participants/groups etc. receive feedback before disseminating the results of the research?**

Feedback on the Outcomes of the research will be provided through posting of an article on the research outcomes to ISACA, IT Audit communities, and LinkedIn at the end of the research after the outcomes of the Thesis has been published by the Institution.

**Outline your informed consent process and details of the data management plan.**

The following statement will be provided on the first page of the survey detailing how the data obtained will be handled and used for.

Dear Respondent,

**Invitation to participate in an academic research study**

My name is Siviwe Prudence Tyaliti and I am currently studying towards a Master's Degree in Internal Auditing with the Cape Peninsula University of Technology, in Cape Town. My research topic is **"Effects of Rapid Technology Advancement on IT audit Skills and Competencies within the Financial Services Sector in South Africa."** I kindly request your assistance in completing this questionnaire based on your knowledge and experience in IT Audit assurance, IT risks, IT controls, IT governance as well as consulting services. Completing this questionnaire will take approximately 10 minutes. The responses obtained from this study will contribute towards providing guidance on implementation and monitoring of IT audit Skills and Competencies in South Africa in order to enhance effectiveness and value-add within the IT audit operations.

The responses obtained in this study will be kept confidential and will only be used for research purposes only, including publication in academic journals. The final report, and any other articles developed from the responses obtained, will not include any information identifying the respondents. The name and email address captured on completion of this form will be kept anonymous in aggregated data. Should you have any enquiries, please feel free to contact;
me at 0788547019 or my supervisor Prof J. Dubihlela on email: dubihlelaj@cput.ac.za

A question requesting consent of the respondent will have to be answered "Yes" before the questionnaire can move to the next question, otherwise the questionnaire will end.

***Appendix G TurnIt-In Individuality Report***

MTech Thesis - *Challenges of Rapid Technology Advancement on IT Audit Skills and Competencies in South Africa*

ORIGINALITY REPORT

| 8% | 7% | 2% | 3% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | hdl.handle.net<br>Internet Source | <1% |
| 2 | vital.seals.ac.za:8080<br>Internet Source | <1% |
| 3 | etd.cput.ac.za<br>Internet Source | <1% |
| 4 | pt.scribd.com<br>Internet Source | <1% |
| 5 | es.scribd.com<br>Internet Source | <1% |
| 6 | uir.unisa.ac.za<br>Internet Source | <1% |
| 7 | repository.up.ac.za<br>Internet Source | <1% |
| 8 | arakmu.ac.ir<br>Internet Source | <1% |
| 9 | dspace.nwu.ac.za<br>Internet Source | <1% |

| | | |
|---|---|---|
| 10 | Submitted to University of Pretoria<br>Student Paper | <1 % |
| 11 | Submitted to University of Stellenbosch, South Africa<br>Student Paper | <1 % |
| 12 | www.marcumllp.com<br>Internet Source | <1 % |
| 13 | static.pmg.org.za<br>Internet Source | <1 % |
| 14 | ebin.pub<br>Internet Source | <1 % |
| 15 | repository.nwu.ac.za<br>Internet Source | <1 % |
| 16 | core.ac.uk<br>Internet Source | <1 % |
| 17 | www.theiia.org<br>Internet Source | <1 % |
| 18 | Submitted to University of Adelaide<br>Student Paper | <1 % |
| 19 | Submitted to University of East Anglia<br>Student Paper | <1 % |
| 20 | researchspace.ukzn.ac.za<br>Internet Source | <1 % |
| 21 | eprints.bournemouth.ac.uk | |

## *Appendix H Certificate of Editing*

PROFESSIONAL EDITING SERVICES
*Stand out for the Write reasons*

**Gerald T du Preez**
PhD
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Brantwood, Kuils River, 7580
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geralddu9@gmail.com

### Certificate of Editing

**This serves to confirm that copy-editing and proofreading services were rendered to**

**SIVIWE PRUDENCE TYALITI**

**For a master's thesis entitled:**

**Effects of Rapid Technology Advancement on IT audit skills and competencies within the financial services sector in South Africa**

**with final word count of 37 414 on 5 November 2023**

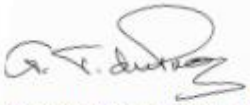
*I am a member of the Professional Editors' Guild (member number DUP015) and commit to the following codes of practice (among others):*

- *I have completed the work independently and did not sub-contract it out*
- *I kept to the agreed deadlines and/or communicated changes within reasonable time frames*
- *I treated all work as confidential and maintained objectivity in editing*
- *I did not accept work that could be considered unlawful, dishonest or contrary to public interest*

*I uphold the following editing standards:*

- *proofreading for mechanical errors such as spelling, punctuation, grammar*
- *copy-editing that includes commenting on, but not correcting, structure, organisation and logical flow of content, formatting (headings, page numbers, table of contents, etc.), eliminating unnecessary repetition*
- *checking citation style is correct, punctuating as needed and flagging missing or incorrect references*
- *commenting on suspected plagiarism and missing sources*
- *returning the document with track changes for the author to accept*

**I confirm that I have met the above standards of editing and professional ethical practice. The content of the work edited remains that of the student.**



**Gerald T du Preez, PhD**

Membership: Southern African Freelancers' Association and Professional Editors' Guild (Membership #DUP015)