AN ARTIFICIAL INTELLIGENCE MODEL TO ENHANCE THE CHARTERED ACCOUNTANCY PROFESSION

by

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DECLARATION

I, Fulufhelo Denge hereby declare that the minor dissertation submitted to the University of Johannesburg is my own work and has not previously been submitted to another university or higher education institution.

ABSTRACT

Artificial intelligence (AI) in today's society has changed the way in which people live and work; however, organisations are yet to fully realise the benefits of incorporating AI in the chartered accountancy (CA) profession. This research investigates the impact that AI will have on the CA profession, specifically within the discipline of applied information systems. The importance of this study lies in ensuring that CAs are kept abreast of the changes and opportunities presented in the Fourth Industrial Revolution.

A quantitative approach was adopted. Questionnaires were distributed in electronic format to CAs in one of the big four auditing firms in South Africa. Data was analysed and processed to facilitate comparisons and identify relationships that existed within the data. The questionnaire identified that there was indeed a need to upskill CAs in (i) AI, (ii) big data analysis, (iii) cyber security, (iv) robotic process automation and (v) Python for Accounting and Finance Professionals. This study further recommended areas for future research by including other audit firms, conduct more analyses among the respective audit firms and to increase the number of unit analyses such as the SAICA and other institutions that provide chartered accountancy accreditation.

Keywords: Fourth Industrial Revolution, Artificial Intelligence, CA skills and competencies

DEDICATION

This work is dedicated to my father, Reuben “Reubs” Denge. Thank you so much for inspiring me. You are truly an amazing father and role model.

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Abbreviations/Acronyms	Explanation
ACCA	Association of Chartered Certified Accountants
AI	Artificial Intelligence
APC	Assessment of Professional Competence
CA	Chartered Accountant
CAs	Chartered Accountants
CA(SA)	South African Chartered Accountant
CAW	Chartered Accountants Worldwide
CIMA	Chartered Institute of Management Accountants
CPD	Continuing professional development
CTA	Certificate in the Theory of Accounting
ESs	Expert systems
ES	Expert system
GIBS	Gordon Institute of Business Science
ICAEW	Institute of Chartered Accountants in England and Wales
IDPs	Individual development plans
IDP	Individual development plan
IFAC	International Federation of Accountants
IoT	Internet of Things
ITC	Initial Test of Competence
SAICA	South African Institute of Chartered Accountants
SAIPA	South African Institute of Professional Accountants
SAQA	South African Qualifications Authority
SPSS	Statistical Package for the Social Sciences
4IR	Fourth Industrial Revolution

CHAPTER 1: INTRODUCTION AND STUDY LAYOUT

1.1 Background

In 2019, during the appointment of the presidential commission on the Fourth Industrial Revolution (4IR), President Cyril Ramaphosa highlighted that "[u]nless we adapt, unless we understand the nature of the profound change that is re-shaping our world and unless we readily embrace the opportunities it presents, the promise of our nation's birth will forever remain unfulfilled" (SAICA, 2019b). This quotation brings light to the importance of embracing the inevitable change that the 4IR is likely to bring about in today's society. Emphasis on the chartered accountancy profession and the influence that technology such as Artificial Intelligence (AI) will have on this profession will be discussed in this study.

Technologies such as Blockchain, Artificial Intelligence and the Internet of Things (IoT) are all driven by 4IR which influence the accounting and auditing professions through shaping the future of jobs along with changing the required skillset in these fields (Kruskopf, Lobbas, Meinander, Söderling, Martikainen & Lehner, 2019). The Fourth Industrial Revolution is characterised by mega trends such as the Internet of Things, Blockchain and Artificial Intelligence which are shifting the way in which people interact and live (Schwab, 2016).

Artificial Intelligence (AI) was first invented in 1956 and from its time of inception to the 1970s its focus was mainly on neural networks, as research at the time looked at topics such as problem solving and figurative methods. However, research in AI evolved from 1980 to 2010, as it focused on machine learning. Today, AI looks at deep learning (SAS, 2019). AI enables machines to learn from experience in order to modify new activities that will perform the same activities that a human does. The most common example of AI in today's society is self-driving vehicles which make use of natural language processing (SAS, 2019). Albeladi, Khan & Khan (2014) explain that the essence of AI lies in its ability to perform specific activities that predict, improve and learn non-cognitive tasks. This is based on its intrinsic ability to think about the future and plan for it based on current patterns. Džbánková & Sirůček (2018) mention that the power of AI lies in its ability to perform intellectual tasks that are likely to change individuals, organisations, governments and society. Through the advent of AI,

organisations and society are now rethinking the future in terms of their capabilities, innovation and future jobs and skills.

DBS Bank provides an insightful use case on how AI is being deployed and applied to the finance industry with regards to the CA profession. DBS Bank developed predictive tools to provide its stakeholders with informative financial insights. These predictive tools aim to estimate balance sheet, income and expenses as well as key financial metrics. Successful deployment of these tools will impact resource productivity and its business (ISCA, 2018).

Slyozko and Zahorodnya (2016) state that the accounting profession has played a significant role in society for the past five centuries. The significance of accountancy over time has been through its multiple roles in society along with the purpose that it serves in all sectors such as agriculture, construction, trade, hospitality and law. Chartered accountants (CAs) work in a number of sectors performing a wide range of roles. However, each CA performs three key underlining functions. Firstly, CAs are required to report on an organisation's financial performance. Secondly, they fulfil an advisory role while lastly, being required to solve complex issues through managing and advising decision makers on actions that will steer the organisation in the right direction (Chartered Accountants Ireland, 2019).

Founded in 1894, the South African Institute of Chartered Accountants (SAICA) is an accounting professional body in South Africa accredited by the Independent Regulatory Board for Auditors. SAICA plays an integral role in the chartered accountancy discipline, both locally and internationally in the business sector. The primary role of SAICA is to uphold and enhance the CA(SA) designation through the governance of a constitution comprising the code of conduct (SAICA, 2018d).

The chartered accountancy profession is now presented with a number of new opportunities and challenges: data analytics, process automation as well as Artificial Intelligence are just a few emerging technologies that are disrupting CAs' role in the business environment (Bizcommunity, 2018). *Embrace 4IR and upskill yourself for the 21st century* is just one of the learning programmes institutions such as the University of Johannesburg and SAICA are working on together in ensuring that CAs are well-equipped to navigate the Fourth Industrial Revolution (4IR) (SAICA, 2019b). CA2025 refers to an initiative pioneered by SAICA aimed at identifying and understanding the

skills that CAs ought to possess for the future. SAICA states that, with technological changes, CAs will now be required to invest in their careers through skills development. It is imperative that CAs continue to evolve in this ever-changing business environment. Therefore, developing and harnessing CAs' expertise, knowledge and competencies forms a critical aspect in creating a new service and value model (SAICA, 2018b).

1.2 Research Problem

The discipline of chartered accountancy deals with both the collection and interpretation of an organisation's financial information (Atrill & McLanely, 2017). Thus, CAs provide decision makers with organisations' financial status through financial statements (Coovadia, 2019). In 2020, Prof Tshilidzi Marwala highlighted that "[A]I is proving to be such powerful technology that it is revolutionising all aspects of our lives" (UJ,2020). This quotation highlights the value of this study; as predictive tools, chatbots and machine learning all indicate how AI is used today. Such technologies have improved how people live, work and interact (Coovadia, 2019). However, emerging 4IR technologies such as AI bring forth uncertainties on the future of chartered accountancy due to the possibility of machine learning systems replacing chartered accountants.

This study seeks to identify and explore the skills that CAs will need to harness in order to remain relevant in the 4IR. In addition to the main research objective, this study also seeks to establish the following secondary objectives:

- Examine the probability of 4IR influencing the CA profession
- Examine which skills CAs need to acquire in order to keep abreast of the challenges and opportunities that the 4IR will present

1.3 Research Questions

1.3.1 Main Research question

The main research question aims to explore the problem statement:

What will the effect of AI be on the chartered accountancy discipline?

1.3.2 Sub-questions

The main research question is explored by using the following sub-questions:

1) What are the general chartered accountancy skills and competencies for other professional bodies (African and international)?
2) How do the skills and competencies in the South African context differ from other African and international chartered accountancy skills and competencies?
3) What are the advantages and disadvantages of AI in the chartered accountancy profession?
4) How will the disadvantages of AI pose as a threat to CAs within the firm?
5) How knowledgeable are CAs within the firm regarding AI?
6) What skills will CAs need to acquire to keep abreast with the changes that AI will bring?
7) How do CAs in the firm perceive the prospective chartered accountancy skills in terms of awareness and effectiveness?

1.4 Chapter Layout

This study is divided into five chapters. Chapter 1 introduces the research study by providing context whilst highlighting the research problem, research objectives and the research questions. Chapter 2 provides literature on the study by referencing various academics on topics relating to AI and chartered accountancy. Chapter 3 specifies the research methodology undertaken by the researcher and for the reader to understand why this study has been undertaken. In addition, Chapter 3 examines how the research problem and research questions have been formulated whilst looking at the sample size. Chapter 4 presents and discusses the research findings. Chapter 5 provides an overview on this study by revisiting the main research question and the sub-questions as detailed in chapter 1 in order to provide answers based on the research findings and the literature. This chapter recommends and proposes areas for future research.

1.5 Conclusion

The value of the auditing and accounting professions depends on the professional's ability to adapt to change in order to continuously provide an excellent service. There is a need for CAs to gain new skills and knowledge in order to remain relevant and competitive in today's dynamic business environment (Wessels, 2004). This chapter highlights various aspects which have an impact on the chartered accountancy profession. This chapter also introduces the Fourth Industrial Revolution along with the impact that technologies such as Blockchain, Artificial Intelligence and the Internet of Things have on shaping the future of jobs and required skills. It also discusses the importance of chartered accountancy over the past five centuries.

The next chapter studies the existing literature of the skills and competencies of a CA along with the challenges facing CAs in the 4IR.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Artificial Intelligence (AI) in today's society has changed the way in which people live and work. The use of self-driving vehicles and the ability to understand one's speech using smart devices indicates its influence in today's context (Makridakis, 2017). Albeladi et al. (2014) mention that the essence of AI lies in its ability to perform specific activities that predict, improve and learn non-cognitive tasks. The contrast between cognitive and non-cognitive tasks is that non-cognitive tasks relate to patterns of thought and behaviour (Bjorklund-Young, 2016), while cognitive tasks, on the other hand, involve the processing, interpretation and recollection of new information in order to use it at a later stage (Kester & Kirschner, 2012).

The previous chapter has provided context and the rationale of the research topic. This chapter provides an in-depth analysis on chartered accountancy and AI. This chapter further assesses traditional competencies along with new competencies, while discussing the challenges facing the chartered accountancy profession in the Fourth Industrial Revolution.

2.2 Accounting Professional Bodies

Huang, Kong and Tsang (2019) mention that the key responsibilities of professional accountancy bodies include providing a framework for the self-regulation of the accounting profession, administering members' training, and provide students or future members with examinations. Comprehensive ethical and educational requirements play a significant role in encouraging the development of the accounting profession.

The International Federation of Accountants (IFAC) (2007) states that one of the fundamental goals of any professional body is to provide assurance on the quality of the services provided by its members. In doing so, accounting professional bodies must be committed to upholding and promoting high-quality professional practices through their member regulations. The International Federation of Accountants (IFAC) (2007) further mentions that professional bodies need to regulate the activities and the conduct of its members to ensure that their responsibility to the community is fulfilled. There are a number of professional accountancy bodies/associations, each with its

own history, philosophy, internal structure and means to enable candidates to gain the professional qualifications required to carry out chartered accountancy. A number of these institutions have had a great influence in determining what society recognises or perceives as chartered accountancy (Roslender, 2002).

The IFAC supports the creation, adoption and implementation of high-quality international standards by ensuring that these standards establish a future-ready accountancy profession (International Federation of Accountants (IFAC), 2007). Chartered Accountants Worldwide (CAW) is a professional accountancy organisation that has been in existence for over 150 years and strives to ensure international excellence in the chartered accountancy profession by facilitating, developing and enhancing the importance of the role of chartered accountancy worldwide (Chartered Accountants Worldwide, 2019). Below is a list of institutes of both African and Commonwealth countries which fall under CAW:

- Chartered Accountants Australia and New Zealand
- Chartered Accountants Ireland
- Chartered Institute of Accountants of Malawi (ICAM)
- Institute of Chartered Accountants of Pakistan (ICAP)
- Institute of Indonesia Chartered Accountants (IAI)
- Institute of Singapore Chartered Accountants (ISCA)
- The Institute of Chartered Accountants of Bangladesh (ICAB)
- The institute of Chartered Accountants in England and Wales (ICAEW)
- The Institute of Chartered Accountants of India (ICAI)
- The institute of Chartered Accountants of Scotland (ICAS)
- The Institute of Chartered Accountants of Sri Lanka (CA Sri Lanka)
- The Institute of Chartered Accountants of Nigeria (ICAN)
- The Institute of Chartered Accountants of Zimbabwe (ICAZ)
- The South African Institute of Chartered Accountants (SAICA)
- Zambia Institute of Chartered Accountants (ZICA)

2.3 The South African Institute of Chartered Accountants

Founded in 1894, SAICA continues to play an integral role in the chartered accountancy discipline. Its main objective is to serve the interests of the chartered accountancy profession and society. This is achieved by maintaining professional standards and the integrity of the CA(SA) designation, both locally and internationally (SAICA, 2020c). SAICA's primary role is to uphold and enhance the CA(SA) designation through the governance of a constitution comprising the code of conduct (SAICA, 2018b). SAICA reported that as of March 2020, there were 46 382 qualified CAs. This figure comprises retired, unemployed and employed CAs (SAICA, 2020a). The South African Institute of Chartered Accountants (SAICA), Chartered Institute of Management Accountants (CIMA), South African Institute of Professional Accountants (SAIPA) and the Association of Chartered Certified Accountants (ACCA) all constitute as accounting professional bodies in South Africa (SAICA, 2020c).

2.3.1 Steps to become a CA(SA)

According to the South African Qualifications Authority (SAQA), the CA(SA) title is predominately for a qualification in accounting, auditing, tax and financial reporting in South Africa (SAQA, 2017). Obtaining the CA(SA) designation is not entirely based on the candidate's capability but rather a combination of competence and pervasive skills in order to ensure that the candidate is able to perform accounting-related tasks in a fast-paced environment. Figure 2.1 is a guideline on the path one embarks on in becoming a CA in South Africa (SAICA, 2018a):

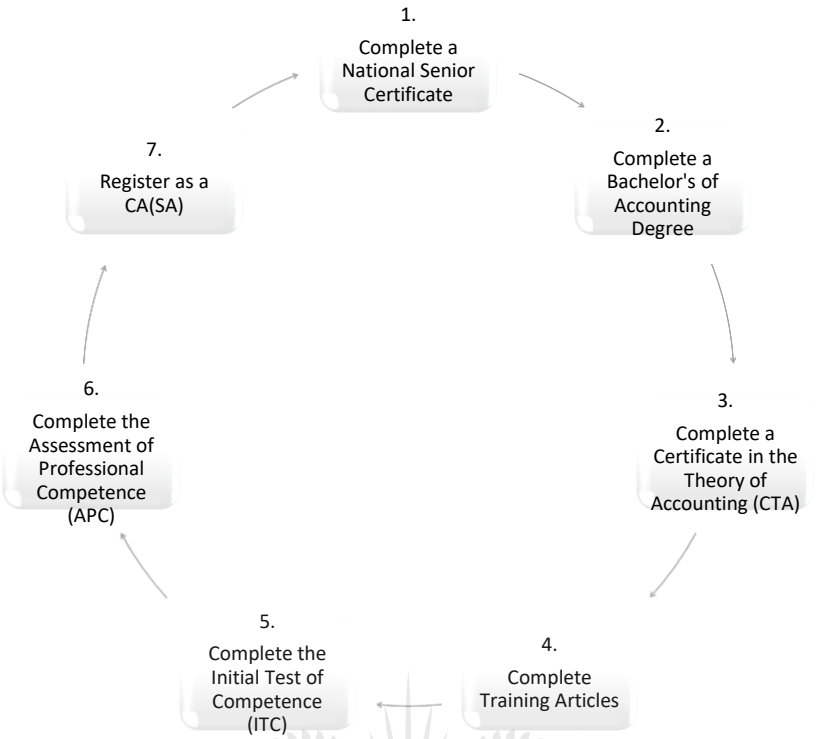

Figure 2.1: Steps to become a CA(SA) (Author's Own)

The overall time required to become a CA(SA) is seven years, the steps below detail this journey:

1. *Step 1*: A candidate is required to complete a National Senior Certificate with matriculation exemption with subjects such as pure Mathematics, English and Accounting.
2. *Step 2*: A candidate is required to complete a Bachelor's of Accounting degree over a period of three years from an institution accredited by SAICA.
3. *Step 3*: A candidate is required to complete a yearlong Certificate in the Theory of Accounting (CTA) through an accredited university.
4. *Step 4:* A candidate is required to complete training articles for three years through a training office.
5. *Step 5*: A candidate is required to complete the Initial Test of Competence (ITC) which consists of two 8 hour examinations. ITC is written when the candidate commences with their training articles, written in March. A prerequisite for admission is the successful completion of the CTA.

6. *Step 6*: A candidate is required to complete the Assessment of Professional Competence (APC), which is an 8 hour examination. APC is written when the candidate is in their second year of training articles, written in November. To qualify for this, the candidate must have successfully passed ITC and completed a minimum of twenty months of a registered training contract through an accredited training office.

7. *Step 7*: A candidate is required to register as a CA(SA) through SAICA.

2.3.2 Skills and competencies

SAICA developed a competency framework in 2008 which outlines the skills and competencies expected of each of its candidates before joining the profession. The competency framework has since evolved to enable students to prepare for SAICA examinations through the use of academic programmes (South African Institute of Chartered Accountants, 2019). The competency framework outlines universal skills to which SAICA refers as "pervasive skills" to integrate with accounting competencies.

2.3.2.1 Pervasive skills

Ethics and professionalism play an integral part in the role CAs play in organisations. Therefore, before joining the profession, each candidate is required to demonstrate that they uphold the highest level of ethical behaviour through the use of ethical reasoning. This also includes demonstrating their understanding of their role in protecting the public's interest while ensuring that due diligence is performed in an honest and dignified manner. Candidates are also required to demonstrate their objectiveness and independent discretion regarding client matters; more importantly, not deriving personal benefits from their actions. In addition, candidates are expected to adhere to the laws and standards that govern the professional body while ensuring the protection of confidential information (South African Institute of Chartered Accountants, 2019).

Personal attributes ensure that individuals are able to lead their clients. Therefore, individuals are also required to demonstrate their ability to work effectively in teams and manage their time to ensure the delivery of projects. Ongoing value creation aims to ensure that all the candidates are continuously acquiring knowledge and skills (South African Institute of Chartered Accountants, 2019).

Professional skills ensure that individuals possess critical thinking, strong business acumen, effective communication both verbal and written, problem-solving and decision-making abilities coupled with knowing how to make use of IT business systems (South African Institute of Chartered Accountants, 2019).

2.3.2.2 CA Competencies

The term *competency* refers to the ability to perform a task in practicality (South African Institute of Chartered Accountants, 2019). SAICA defines *competency* as specific tasks performed by a CA with reference to the application of pervasive qualities and skills that are representative of CAs (South African Institute of Chartered Accountants, 2019). To acquire a competency, a candidate must obtain knowledge, build understanding as well as possess the experience needed to perform tasks (South African Institute of Chartered Accountants, 2019). Knowledge and understanding are the basis for developing the competencies. Candidates are required to demonstrate these from close examinations.

Obtaining knowledge does not result in possessing competency; therefore, the practical application of these competencies is demonstrated when performing tasks (SAICA, 2019). Figure 2.2 demonstrates the competencies that a CA should acquire. The CA competencies are not ranked according to importance. Appendix A details the chartered accountancy competencies.

Figure 2.2: Chartered accountancy competencies (Author's Own)

An outline on each chartered accountancy competency is as follows (South African Institute of Chartered Accountants, 2019):

- Strategy, risk management and governance involve the creation and comparison of an entity's strategy, thus providing recommendations on areas of improvement. It also includes the assessment of an entity's risk management plan and the governance models in place for entities.
- Accounting and external reporting involve assessing the monetary reporting needs and creating the required systems. It also includes performing financial reporting externally as well as customised reporting.
- Auditing and assurance involve assessing and providing guidance on assurance needs while offering assurance and control-related services in order to create, execute and manage the entity's quality control system as well as recognising and replying to reporting irregularities.
- Financial management involves creating or assessing the total financial goals as well as assessing the value of an enterprise in order to plan and monitor the financials of the enterprise. It also includes financial risk management as part of a risk management policy for an entity to create or assess business plans along with financial offers, while evaluating capital investment opportunities in order to identify or provide guidance to businesses that are financially challenged.
- Management decision making and control involve recognising and assessing elements that impact on an entity's financial performance as well as handling the entity's budgeting process and control system to assess the entity's cost allocation, transfer-pricing options and financials and other data used to acquire information to assist in decision making. This is done to recognise, create and improve costing systems in order to meet information requirements regarding the enterprises processes.
- Taxation involves assessing taxpayers' tax profiles along with finding generic tax matters in order to formulate tax calculations, provide guidance on tax matters and perform effective tax administration.

2.3.2.3 African and international skills and competencies

Table 2.1 compares chartered accountancy competency frameworks across various African and international countries. Whilst section 2.2 provided an extensive list of professional bodies, this study aims to analyse how each chartered accountancy framework differs across African and international countries. SAICA's framework is compared to three other frameworks in order to provide a holistic view whilst analysing how the skills and competencies in the South African context differ from other chartered accountancy skills and competencies in developed and developing countries.

Table 2.1: African and international skills and competencies (Chartered Accountants Ireland, 2019; Institute of Singapore Chartered Accountants, 2018; South African Institute of Chartered Accountants, 2019; The Institute of Chartered Accountants of Zimbabwe, 2019)

	South Africa	Zimbabwe	Singapore	Ireland
Pervasive Skills				
Ethics and Professionalism	✓	✓	✓	✓
Personal Attributes	✓	✓	✓	✓
Professional Skills	✓	✓	✓	✓
CA Competencies				
Strategy, Risk Management and Governance	✓	✓	✓	✓
Accounting and External Reporting	✓	✓	✓	✓
Auditing and Assurance	✓	✓	✓	✓
Financial Management	✓	✓	✓	✓

	South Africa	Zimbabwe	Singapore	Ireland
Management decision making and control	✓	✓	✓	✓
Taxation	✓	✓	✓	✓
Big Data Analysis	✗	✗	✓	✗
Cyber Security	✗	✗	✓	✗
FinTech	✗	✗	✓	✗
Introduction to Python for Accounting	✗	✗	✓	✗
Robotic Process Automation: Impact on Finance Professionals	✗	✗	✓	✗
Transforming Finance Through Intelligent Automation	✗	✗	✓	✗
Regulations: RegTech and Digital Risk with Learning Journey	✗	✗	✓	✗

Table 2.1 indicates that the difference is not specifically between developed and developing nations, this is as Ireland (Chartered Accountants Ireland) is a developed country yet its framework is similar to South Africa and Zimbabwe. In addition, Table

2.1, indicates that each of the four Chartered Accountancy frameworks have the following skills and competencies in common:

- Ethics and Professionalism
- Personal Attributes
- Professional Skills
- Strategy, Risk Management and Governance
- Accounting and External Reporting
- Auditing and Assurance
- Financial Management
- Management decision making and control
- Taxation

The difference however lies in the inclusion of the following competencies as detailed in the Institute of Singapore Chartered Accountants framework:

- Big Data Analysis
- Cyber Security
- FinTech
- Introduction to Python for Accounting
- Robotic Process Automation: Impact on Finance Professionals
- Transforming Finance Through Intelligent Automation
- Regulations: RegTech and Digital Risk with Learning Journey

2.3.2.4 New framework for professional learning

As established in Table 2.1, the Institute of Singapore Chartered Accountants is progressive in comparison to the other professional bodies. In addition, the Institute of Singapore Chartered Accountants also provides a new framework for professional learning, to assist CAs and professional bodies to continuously keep abreast of the changes and opportunities presented in the ever-changing business environment.

Figure 2.3 below refers to a new framework for professional learning presented by Hilary Lindsay, a contributing author in the Institute of Chartered Accountants in England and Wales (ICAEW) Industry Report (Seow, Pan, Goh & Leong, 2017). The new framework includes a multi-faceted approach that ensures the adoption of deeper learning.

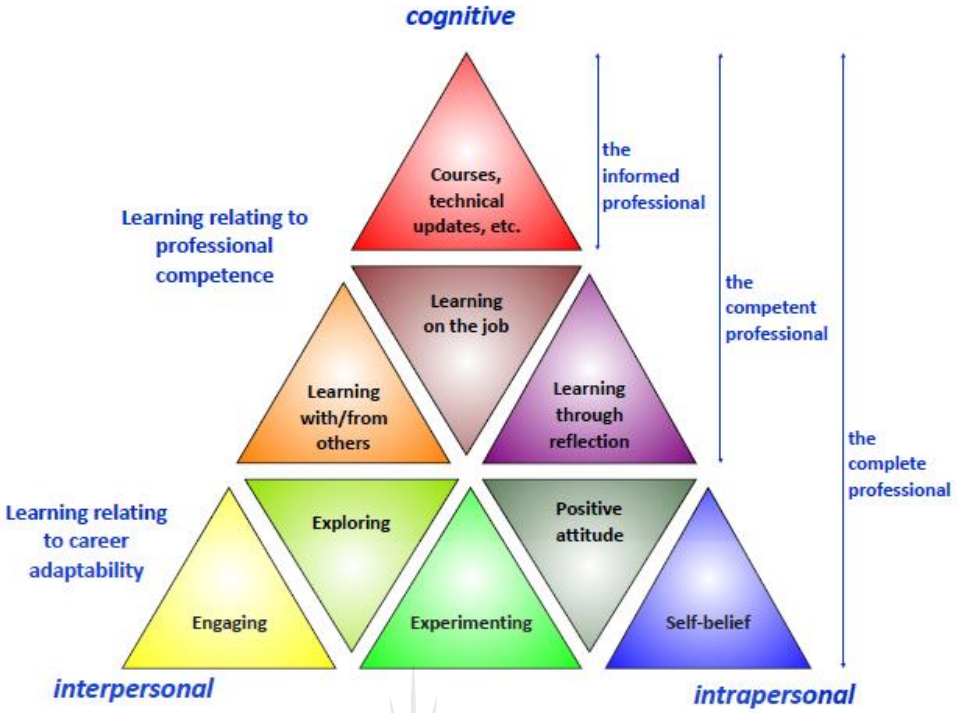

Figure 2.3: A new framework for professional learning (Seow et al., 2017)

The ICAEW refers to a new framework for professional learning comprising three dimensions, namely the cognitive dimension which entails knowledge and skills; secondly, the intrapersonal dimension which looks at how an individual reflects and evolves. The third dimension is interpersonal which looks at how an individual engages with others along with their surroundings.

The five elements that exist across the intrapersonal and the interpersonal learning dimensions are as follows (Seow et al., 2017):

- Engaging with others and their surroundings
- Exploring what is taking place externally
- Experimenting with new concepts
- Having a positive attitude about what lies ahead
- Self-belief in one's capabilities

Engaging, exploring, experimenting, a positive attitude and self-belief refer to the elements SAICA has in place for its continuing professional development (CPD) philosophy; aimed at protecting the public interest through ensuring that there is a

policy in place where members pledge themselves to lifelong learning and develop their careers while displaying the competencies related to their roles. Therefore, this indicates that there will be an emphasis on lifelong learning as the environment continuously changes (SAICA, 2020b).

The new framework for professional learning can be adapted to introduce AI in the CA profession, as it includes a multi-faceted approach that ensures the adoption of lifelong learning. This multi-faceted approach aims to ensure future-ready chartered accountants and strives to ensure ongoing learning and progression in the CA profession (Seow et al., 2017). To achieve this, Professional bodies ought to be conscious and inclusive of 4IR in their CA frameworks. This as the core function of competency frameworks is in outlining the skills and competencies that each CA needs to possess to ensure value creation (South African Institute of Chartered Accountants, 2019).

2.4 Fourth Industrial Revolution

Anderson (2019) stated that the First Industrial Revolution took place in 1765 and was characterised by the emergence of mechanisation. In 1870 came the Second Industrial Revolution which bought forth new sources of energy (gas, electricity and oil). It was also characterised by the age of science and mass production. The year 1969 brought forth the Third Industrial Revolution which was characterised by the inception of the digital age and the nuclear age.

Xu, David and Kim (2018) mention that the Fourth Industrial Revolution (4IR) is a continuation of the Third Industrial Revolution which was characterised by a fusion of technologies between physical, digital and biological spheres. *4IR* is a term coined by the creator and executive chairman of the World Economic Forum, Professor Klaus Schwab. The 4IR is characterised by mega trends such as the IoT, 3D printing, nanotechnology, blockchain and AI which are all shifting the way in which people interact and live (Schwab, 2016). The 4IR is evolving at a rapid rate and its influence is seen in its disruption in all industries worldwide (Schwab, 2016). Xu et al.(2018) further explain that the 4IR is driven with disruptive innovation to have positive effects on core industries and sectors, and will subsequently change the way in which people work and interact with one another.

2.5 Artificial Intelligence

Table 2.1 has indicated that the Institute of Singapore Chartered Accountants currently provides its candidates with the necessary skills to ensure that they are able to keep abreast of the changes presented in the 4IR. In addition, the Institute of Singapore Chartered Accountants reference to FinTech has highlighted the need to expand on Artificial intelligence along with its advantages and disadvantages in the chartered accountancy profession.

Anderson (2019) mentions that the term *AI* has been coined by a computer scientist called John McCarthy in 1955. AI refers to an intelligent system that is "computerised". It enables its users to make decisions as well as perform activities that a human being would typically perform. Anderson (2019) further mentions that AI frees up our time, as it is able to carry out mundane processes on our behalf. An example of this is the use of smart home devices which are able to control the lighting function, for instance when one enters the house through the use of voice-over commands. AI refers to stimulating human intellect on a computer in order to render the system effective in finding and utilising the correct piece of information at a specified stage in problem solving. AI may be referred to as a topic that focuses on "computational models" which can reason and behave rationally (Konar, 2018).

The University of Pretoria (2017) states that AI is intended to identify patterns, learn from experiences and subsequently make decisions that allow quicker development in all sectors where intelligence plays a role. Further mention is made of two key elements that drive growth in AI (Access Partnership, 2017). The first being an increased amount of digested data in the economy and secondly, the endless access to computer control along with lower data costs, all accessible in the cloud. The University of Pretoria (2017) further mentions that through AI, value creation is likely to take place through fusing labour and physical capital to optimise productivity, and through automating routine tasks employees are able to focus on high value-added activities (Access Partnership, 2017).

AI is a universal phenomenon that refers to the use of a "computer to replicate intelligent behaviour" (Shubhendu & Vijay, 2013:31). Therefore, one can conclude that AI has the potential to optimise and streamline some activities that a human being

would typically perform. This would increase the turnaround time and allow humans to focus on key areas.

2.5.1 Advantages and disadvantages of Artificial Intelligence

The McKinsey & Co report (Manyika, Lund, Chui, Bughin, Woetzel, Batra, Ko & Sanghic, 2017) predicted that 15 percent of the global workforce is likely to be replaced by automation between 2016 and 2030. The McKinsey & Co report emphasises that this does not indicate that there will be a decline in the employment rate, but rather an evolution in the types of jobs that will be available, given that some activities will be automated due to AI.

AI will simplify some activities and enable them to be more precise and effective while some tasks will remain partially completed by human beings. The McKinsey & Co report further mentions that only five percent of jobs that exist in today's society will be replaced fully by AI enhanced technologies (Manyika et al., 2017). Plunkett (2020) mentions that AI's greatest benefits in society will be its ability to solve complex problems as well as assist with the increase in data security, a decline in online fraudulent activities, a decline in physical crimes and subsequently a decline in the cost of certain products and services.

Shubhendu and Vijay (2013) state that unlike human beings a machine is able to complete a particular task without the need of a break. Therefore, machines eliminate lunch breaks or teatime and subsequently increase the turnaround time. Shubhendu and Vijay (2013) look at the use of an artificial mind as opposed to the thought process when a human being makes a decision. An artificial mind makes use of logical and feasible decisions, whereas as human beings consider their emotions when making decisions. Borana (2016) reiterate Shubhendu and Vijay's (2013) view that a key advantage of AI is its rational decision-making ability based on its use of facts and not emotions.

Plunkett (2020) provides a holistic view on AI by mentioning that the potential misappropriation of AI could be a possible concern in the future. This is as AI encourages companies to capture more personal data regarding people along with their personal interests, given that AI becomes more prevalent when the size of its

data pool increases. This may bring about ethical and privacy concerns, driving governments worldwide to new levels of regulatory controls.

Borana (2016) also provide an interesting disadvantage of AI and that is its inability to elaborate on the logic and reasoning used when making certain decisions. In addition, any possible malfunctions could result in AI providing wrong solutions. Shubhendu and Vijay (2013) emphasise that a major disadvantage of AI is the risk of a breakdown and loss of data because AI relies heavily on data. AI has the possibility to reduce the challenges faced by human beings; however, intelligent machines may not always replace humans. For instance, given that AI does not show emotions, it is not always best to use it in all industries; for instance, in some industries such as healthcare, expressing emotions to a patient is part of the job (Shubhendu & Vijay, 2013).

2.5.2 SA's view on the impact of AI

A report published by Accenture and the Gordon Institute of Business Science (GIBS) has found that South Africans are concerned that AI is likely to replace their jobs and subsequently create income inequality (Schoeman, Moore, Seedat & Chen, 2017). Further mention is made that some organisations in South Africa are still using legacy systems and technologies, and are only now starting to embrace the potential that AI has to offer. This is as 78% of South African executives mention that there is a need to improve their competitiveness by creating innovative AI technologies. However, only a third of these organisations are planning on making these investments in AI in the next three years.

The Accenture and the Gordon Institute of Business Science (GIBS) report further indicates that South Africa is facing a number of challenges in fully integrating AI technologies in their operations which are affecting businesses and government at large(Schoeman et al., 2017). Therefore, this is affecting the growth and competitiveness that AI brings. In addition, apart from integrating AI technologies, organisations in South Africa need to provide skills and development training to its employees, particularly to those employees whose income and employment will be affected while establishing ethical codes for AI in order to create adaptive regulations to keep abreast of the technological changes and incorporate human intelligence with machine intelligence.

The SAICA competency framework needs to incorporate machine learning under IC-6 which refers to “Understanding how IT impacts a CA’s daily functions and routine” (South African Institute of Chartered Accountants, 2019). The inclusion of machine learning in the competency framework will assist CAs in coding accounting entries as well as optimise the accuracy of rules-based approaches. Machine learning is also likely to provide advancements in early fraud detection and predictive models to forecast revenues (ICAEW Thought Leadership, 2018). In closing: the Accenture and the Gordon Institute of Business Science (GIBS) report mentions that AI has the ability to improve human existence by optimising the way in which we live and work only if used correctly (Schoeman et al., 2017).

2.5.3 AI’s influence on chartered accountancy

The history of AI in the accounting discipline dates back to the 1980s through its application of predominately expert systems (ESs). An ES can be defined as a software program intended to replace human intervention by replicating human expertise along with storing tacit knowledge to assist in solving dynamic accounting problems (Sutton, Holt & Arnold, 2016). O’Leary (2003), however, mentions that the intended purpose of ESs was not fully realised, given its reliance on logic which subsequently resulted in errors. Recent developments in AI provide the accounting discipline with an opportunity to prioritise research on ES application to greater heights that will enable chartered accountants (CAs) to benefit from the use of AI (Seow et al., 2017).

Kruskopf et al. (2019) mention that digitalisation will benefit the accounting and audit professions in terms of increased productivity, and save time and resources when collecting and interpreting financial data. Inherently, there is a need for CAs to gain new skills and knowledge in order to remain relevant and competitive in the dynamic business environment (Wessels, 2004).

The chartered accountancy profession is now presented with a number of new opportunities and challenges: data analytics, process automation as well as Artificial Intelligence are a few emerging technologies that are disrupting chartered accountants’ role in the business environment (Bizcommunity, 2018). SAICA states that with technological changes, CAs will now be required to invest in their careers through skills development, as it is imperative that they continue to evolve in this ever-

changing business environment. Therefore, developing and harnessing chartered accountants' expertise, knowledge and competencies are critical aspects in creating a new service and value models (SAICA, 2018a). In achieving this SAICAs CA2025 initiative aims to continuously develop CA competencies required for future CA(SA).This initiative strives to increase SAICAs focus on digital competencies as well as incorporating trends and events that will impact the value that CAs provide (SAICA, 2018b).

2.6 Conclusion

As deduced from the above literature, "[T]here is nothing permanent except change". These are the words of Heraclitus, an ancient Greek philosopher, which brings forth the importance of remaining abreast and adapting to different ways of working. AI research focuses on developing and analysing algorithms to learn and perform smart behaviour with limited human intervention. These techniques, to name a few, have been and continue to be applied to a wide range of issues arising in robotics and e-commerce (Shubhendu & Vijay, 2013).

The ICAEW Industry Report (Seow et al., 2017) proposes a new framework for professional learning which aims to ensure that professional accountants continue to embark on lifelong learning to ensure future-ready chartered accountants. Furthermore, the inclusion of big data analysis, cyber security, FinTech, robotic process automation and python for accounting; as stated in the Institute of Singapore Chartered Accountants' Competency framework, highlights the need for other professional chartered accountancy bodies to align their skills and competencies in order to ensure that their profession continues to add value. This, therefore, indicates that emerging 4IR technologies such as AI bring forth uncertainties in the future of the chartered accountancy profession due to the possibility of machine learning systems replacing CAs.

This chapter detailed the chartered accountancy profession while unpacking each of the required CA skills and competencies. The second fold of this chapter looked at the Fourth Industrial Revolution as well as the opportunities and challenges it presents pre-qualification and post-qualification.

The next chapter discusses the research methodology used for data collection and data analysis.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter details the methodology used to solve the research problem. Kothari (2004) adds that research methodology looks at the various steps undertaken by the researcher to solve the problem. Kothari (2004) further specifies that research methodology aims to understand why a study has been undertaken as well as how the research problem and research questions have been formulated while looking at the logic applied in analysing the data. Saunders, Lewis and Thornhill (2016) outline the essence of research design using a research onion. Chapter 3 discusses each layer in the research onion (Figure 3.1).

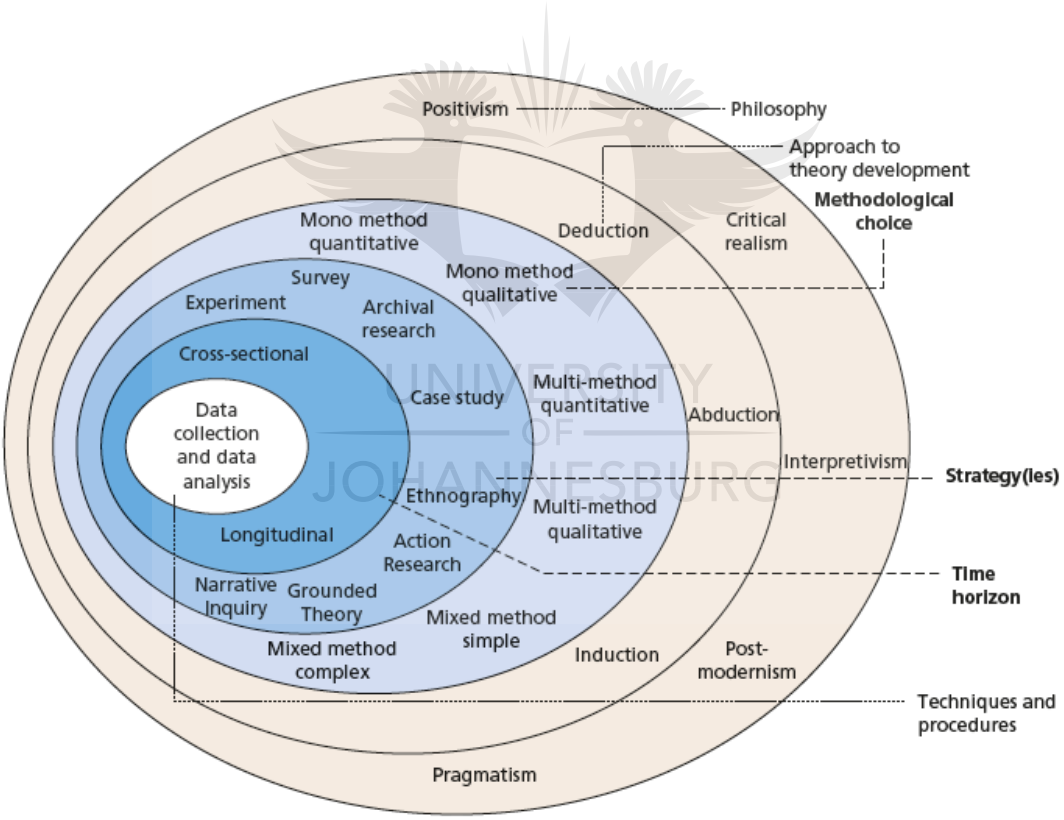

Figure 3.1: Research onion (Saunders et al., 2016)

3.2 Research Philosophy

Research philosophy refers to a classification of beliefs and assumptions pertaining to the creation of knowledge along with the nature of that knowledge (Saunders et al., 2016). Table 3.1 provides five research philosophies (positivism, critical realism, interpretivism, postmodernism and pragmatism) which guide researchers to classify beliefs and assumptions to create knowledge.

Table 3.1: Different research philosophies (Saunders et al., 2016; Tuli, 2010)

Research philosophy	**Description**
Positivism	Relates to the "logical stance of the natural scientist and entails working with an observable social reality to produce law-like generalisations" (Saunders et al., 2016:135) Tuli (2010) describes positivism as a structured technique for combining deductive logic with empirical observations of individual behaviour to enable one to learn and confirm a set of probabilistic laws that can be utilised to foresee general patterns pertaining to human activity.
Critical realism	"Focuses on explaining what we see and experience, in terms of the underlying structures of reality that shape the observable events" (Saunders et al., 2016:138)
Interpretivism	"…emphasises that humans are different from physical phenomena because they create meanings. Interpretivists study these meanings" (Saunders et al., 2016:140) Tuli (2010) adds that researchers who function in the interpretivist paradigm are realistic, as they make use of real-life situations as and when they unfold in reality.
Postmodernism	"…emphasises the role of language and of power relations, seeking to question accepted ways of thinking and give voice to alternative marginalised views" (Saunders et al., 2016:141)
Pragmatism	"…asserts that concepts are only relevant where they support action" (Saunders et al., 2016:143)

Objectivist epistemology has been adopted, as this study aims to provide reliability while exploring what the effect of AI will be on the chartered accountancy discipline. A questionnaire and sampling are aimed at producing law-like generalisations on the effect that AI will have on the chartered accountancy profession. In addition, the research findings aim to facilitate in providing scientific assumptions.

Positivism has been chosen as the research philosophy for this study, based on its epistemological underpinning. The researcher seeks to identify and measure the effect of AI on the chartered accountancy profession in order to provide a rational explanation for it. In addition, the rational explanation aims to establish relationships that exist between different variables to relate them to the theory. The process is deductive in nature as the researcher made use of academic literature/theory to design a research strategy to measure the theory.

3.3 Research Approach

Saunders et al. (2016) state that the research approach is centred round the development of theory. Deductive, inductive and abductive approaches are research approaches. However, research approaches cannot be discussed in isolation of the research reasoning as detailed in Table 3.2.

Table 3.2: Distinction between reasoning and research approach (Saunders et al., 2016)

Reasoning	Research Approach
Deductive reasoning arises when the conclusion is established rationally from a set of premises, implying that in the event the conclusion is true, the premises are true as well.	The *deductive approach* takes place when a researcher makes use of academic literature to design a research strategy to measure the theory.
Inductive reasoning arises when a gap is identified between the observed premises and the conclusion.	The *inductive approach* takes place when a researcher starts by collecting data to explore a specific phenomenon and subsequently creates theory.
Abductive reasoning arises when the research starts off with a surprising fact that will be observed. In this	The *abductive approach* takes place when a researcher explores a

Reasoning	Research Approach
instance, the surprising fact is the conclusion as opposed to the premises. As a result, the conclusion is able to derive possible premises.	phenomenon only to create a new theory or modify an existing theory.

Deductive approach was selected as the preferred research approach. This was as the research questions were formulated once the researcher had familiarised herself with the theory. The existing premise is that AI will have an effect on the CA profession. The researcher adopted questionnaires to investigate this premise using a specific organisation as the case study. In conclusion, data collection and data analysis were employed to provide the research findings to conclude this study.

3.4 Research Design Methods

Research design methods comprise qualitative research, quantitative research and mixed-method research (Johnson & Christensen, 2014). Qualitative research is the data collection method that is non-numeric such as words or pictures. The basis of qualitative research is that it aims to describe what is seen in order to create new hypotheses and theories. Qualitative research is explorative in nature, as it is commonly used to explore and understand a phenomenon. In addition, qualitative research is used when a researcher aims to understand participants' experiences. MacDonald and Headlam (2011) define *quantitative research* as a research method that aims to measure data and generalise the results obtained from the population. Saunders et al. (2016) add that quantitative research looks at the correlation between variables and subsequently evaluates the variables numerically by use of statistics or graphs. Mixed-method research encapsulates both qualitative and quantitative research as mixed-method researchers find that either one of these methods has the potential to limit their study. Mixed-method research makes use of both numeric and non-numeric data and is therefore both confirmatory and exploratory in nature (Johnson & Christensen, 2014).

Table 3.3 provides a detailed distinction between quantitative and qualitative research by looking at the relevant characteristics to guide the researcher in establishing a suitable research design method for this study.

Table 3.3: Distinction between quantitative and qualitative research (MacDonald & Headlam, 2011)

	Quantitative	**Qualitative**
Aim	The aim is to count things in an attempt to explain what is observed	The aim is complete, detailed description of what is observed
Purpose	Generalisability, prediction, casual explanations	Contextualisation, interpretation, understanding perspectives
Tools	The researcher uses tools such as surveys to collect numerical data	Researcher is the data gathering instrument
Data Collection	Structured	Unstructured
Output	Data is in the form of numbers and statistics	Data is in the form of words, pictures or objects
Sample	Usually a large number of cases representing the population of interest Randomly selected respondents	Usually a small number of non-representative cases Respondents selected based on their experience
Objective/ Subjective	Objective - seeks precise measurement and analysis	Subjective – individuals' interpretation of events is important
Researcher role	Researcher tends to remain objectively separated from the subject matter	Researcher tends to become subjectively immersed in the subject matter
Analysis	Statistical	Interpretive

Saunders et al. (2016) further add that quantitative research comprises both mono-method and multi-method research. Mono-method research refers to the use of a

single data collection technique, for instance a questionnaire, while the latter refers to the use of multiple data collection techniques such as questionnaires and structured observations.

This study followed a mono-method quantitative approach, as only questionnaires were used to collect data. The questionnaire aimed to measure constructs relating to chartered accountancy skills, competencies in the African and international context as well as the capability of AI.

Based on MacDonald and Headlam's (2011) explanation on the distinction between quantitative and qualitative research, the researcher has adopted quantitative research based on the following factors:

- The researcher aimed to use a questionnaire.
- The researcher aimed to quantify and understand the effect of AI on the chartered accountancy profession.
- Data analysis was conducted in the form of statistics and graphs.
- The researcher maintained an unbiased and objective stance on what was being studied.

3.5 Research Strategy

Saunders et al. (2016) define the term *research strategy* as the overall plan set out by the researcher to answer the research questions. Table 3.4 describes the different research strategies which could be incorporated for quantitative, qualitative and mixed-method research.

Table 3.4: Different research strategies (Saunders et al., 2016)

Research strategy	Description
Experiment	• Experiments make use of predictions as opposed to research questions. • Experiments aim to observe the likelihood of an independent variable which subsequently changes another dependent variable.

Survey	• Surveys are typically associated with deductive research.
	• Surveys are both explorative and descriptive in nature as they aim to answer the following questions:
	  ○ Who?
	  ○ What?
	  ○ Where?
	  ○ How many?
	• Surveys allow researchers to collect quantitative data while analysing the data qualitatively.
	• Surveys may be used to propose possible reasons for relationships between variables as well as develop models of these relationships.

Archival research	• Archival research involves the extraction of information that is archived (documents, videos, photos etc.) for research purposes. • Archival research requires a researcher to first establish the kind of information that is needed.

Research strategy	Description
	• Based on the nature of archival research, it relies on the researcher's ability to obtain access to view and use the necessary information.
Case study	• The term *case* may refer to a number of things such as an individual, organisation, change process or an association. • A case study refers to a lengthy investigation into a specific topic within its real-life setting. • A case study aims to understand the complexities of the topic.

Based on the explanation on research strategies offered by Saunders et al. (2016), the researcher adopted survey questionnaires to investigate AI in the chartered accountancy profession, using a specific organisation as the case study based on the following factors:

- The study's association to deductive research
- The study's quest to explore the effect of AI on the chartered accountancy profession resulting in the need to understand who, what, where and how many
- The adoption of a quantitative data analysis

3.6 Research Instrument

The researcher created an online questionnaire using Microsoft Forms. The questionnaire comprised 13 questions. All the questions were marked as mandatory to ensure the completeness of the questionnaire. Questions comprised both closed-ended questions and sliding scales. Annexure B provides a sample of the consent letter and questionnaire.

Table 3.5 indicates how each question listed in the questionnaire linked to the main research question as well as the sub-questions. Mapping ensured alignment to the overall objective and literature concerning each sub-question, specially looking at the skills and competency perspective of AI and the CA profession. Each participant was

informed of the ethical considerations taken in the study through use of a consent form. This was done prior to completing the questionnaire.

Table 3.5: Mapping (Author's own)

Number	Question listed in the questionnaire	Main research question and sub-question
1.	For how many years have you been a qualified CA?	Mapped to the main research question: What will the effect of AI be on the chartered accountancy discipline?
2.	How long have you been with the firm?	Mapped to the main research question: What will the effect of AI be on the chartered accountancy discipline?
3.	Do you believe that there is a probability that the chartered accountancy profession will transition in the Fourth Industrial Revolution (4IR)?	Mapped to the main research question: What will the effect of AI be on the chartered accountancy discipline?
4.	Are you aware of Artificial Intelligence (AI)?	Mapped to sub-question 5: How knowledgeable are CAs within the firm regarding AI?
5.	Are you knowledgeable about AI?	Mapped to sub-question 5: How knowledgeable are CAs within the firm regarding AI?
6.	To what extent will AI have an impact on the following chartered accountancy competencies?	Mapped to sub-question 1: What are the general chartered accountancy skills and competencies for other professional bodies (African and international)?
7.	How desirable are the following AI advantages to you?	Mapped to sub-question 3: What are the advantages and disadvantages of AI in the chartered accountancy profession?

Number	Question listed in the questionnaire	Main research question and sub-question
8.	How concerned are you about the following AI disadvantages?	Mapped to sub-question 3: What are the advantages and disadvantages of AI in the chartered accountancy profession?
9.	Of the listed AI disadvantages, which are you most concerned will pose a potential threat to CAs within the firm?	Mapped to sub-question 4: How will the disadvantages of AI pose a threat to CAs within the firm?
10.	Do you believe that it is important for CAs to up-skill themselves with AI skills in order to keep abreast of the changes that 4IR will bring?	Mapped to sub-question 6: What skills will CAs have to acquire to keep abreast of the changes that AI will bring?
11.	Are you aware of big data analysis, cyber security, Python for Accounting and Finance Professionals, robotic process automation?	Mapped to sub-questions 2 and 6: Sub-question 2: How do the skills and competencies in the South African context differ from other African and international chartered accountancy skills and competencies? Sub-question 6: What skills will CAs have to acquire to keep abreast of the changes that AI will bring?
12.	Do you believe that these skills will effectively assist with your overall deliverables?	Mapped to sub-question 6: What skills will CAs have to acquire to keep abreast of the changes that AI will bring?
13.	Do you agree that these skills should be incorporated in your short-term individual development plan (IDP) goals?	Mapped to sub-questions 6 and 7: Sub-question 6: What skills will CAs have to acquire to keep abreast of the changes that AI will bring?

Number	Question listed in the questionnaire	Main research question and sub-question
		Sub-question 7: How do CAs in the firm perceive the prospective chartered accountancy skills in terms of awareness and effectiveness?

Data collection took place by way of self-administered questionnaires using Microsoft Form. The questionnaires were distributed by means of Microsoft Outlook email service to 35 CAs across the firm. Data was collected over a period of six weeks from 18 August 2020 to 28 September 2020. Thirty-one responses were received and the remaining four questionnaires were not returned.

This study adopted a cross-sectional data collection method to establish the relationship between chartered accountancy and AI on a population during a specific point in time. Saunders et al. (2016) define a cross-sectional study as a study that captures a specific point in time. MacDonald and Headlam (2011) add that cross-sectional surveys are employed to obtain information on a population at a specific point in time. In addition, cross-sectional surveys aim to establish the relationship between two factors.

3.7 Population and Sampling

The researcher investigated the possible effect that AI could have on the CA skills and competency by using a particular audit firm as a case study. Chartered accountancy trainees were not considered for the sample. The target population comprised of CAs working across various service lines within the firm in order to understand the complexities pertaining to the research topic. Participants were selected proportionally across different service lines. Participants who were sampled to participate in this study were qualified CAs with at least a year's worth of experience as a qualified CA. This was done to ensure that respondents were knowledgeable about their discipline and well-versed in theoretical expertise to effectively contribute to this study.

Homogeneous sampling looks at a specific sub-group that comprises members who share the same similarities; for instance, a particular occupation or who have reached

a specific level in an organisation (Saunders et al., 2016). O'Reilly (2014) states that researchers select purposive (homogeneous) samples in order to gain access to individuals or settings that reflect a specific criterion. A homogeneous sample was used as 35 responses were targeted and a total of 31 responded. The study focused specifically on understanding a group of individuals who shared the same similarities with regard to qualification, skills and competencies. Table 3.6 provides a breakdown of each respondent in terms of overall experience and firm experience.

Table 3.6: Breakdown of each respondent (Author's Own)

	Overall experience	**Firm experience**
Respondent 1	1-5 years	1-5 years
Respondent 2	6-10 years	6-10 years
Respondent 3	1-5 years	6-10 years
Respondent 4	6-10 years	11-15 years
Respondent 5	6-10 years	11-15 years
Respondent 6	6-10 years	6-10 years
Respondent 7	16-20 years	> 25 years
Respondent 8	16-20 years	16-20 years
Respondent 9	11-15 years	1-5 years
Respondent 10	1-5 years	1-5 years
Respondent 11	6-10 years	11-15 years
Respondent 12	1-5 years	1-5 years
Respondent 13	6-10 years	6-10 years
Respondent 14	1-5 years	1-5 years
Respondent 15	1-5 years	6-10 years
Respondent 16	1-5 years	6-10 years
Respondent 17	11-15 years	11-15 years
Respondent 18	11-15 years	16-20 years
Respondent 19	16-20 years	1-5 years
Respondent 20	21-25 years	1-5 years
Respondent 21	1-5 years	1-5 years
Respondent 22	1-5 years	1-5 years
Respondent 23	1-5 years	1-5 years

	Overall experience	Firm experience
Respondent 24	11-15 years	1-5 years
Respondent 25	1-5 years	6-10 years
Respondent 26	1-5 years	1-5 years
Respondent 27	1-5 years	1-5 years
Respondent 28	1-5 years	6-10 years
Respondent 29	21-25 years	> 25 years
Respondent 30	1-5 years	1-5 years
Respondent 31	1-5 years	1-5 years

3.8 Data Analysis

Mouton (2013) defines *analysis* as segmenting the data collected into manageable components such as relationships and patterns. Analysis plays an integral part in the research process, as the researcher aims to understand the development of various elements pertaining to data. This is achieved by exploring the relationship between variables, constructs and concepts in order to identify any similarities, to subsequently create themes within the data. According to Mukherjee (2019), data analysis serves various objectives such as examining relationships, validating or nullifying existing hypotheses or proposing the outcomes of current occurrences.

Saunders et al. (2016) state that quantitative data is raw data that has not been processed or interpreted. As a result, quantitative analysis techniques such as tables, graphs and statistics assist in converting raw data into meaningful information but more so, to examine trends and relationships within the data. The study adopts descriptive statistics for data analysis. Saunders et al. (2016) further mention the use of software such as Microsoft Excel and SPSS could be used to analyse data statistically. The researcher made use of Microsoft Excel to analyse the data in order to obtain further insight.

3.9 Validity and Reliability

Saunders et al. (2016) explain that reliability refers to when a researcher makes use of the same research design as another researcher and obtains the same results. This indicates that the research is reliable. Kumar (2011) states that the concept of

reliability in relation to research refers to when a research tool is consistent and accurate and this subsequently results in a higher degree of reliability. Mukherjee (2019) adds that reliability refers to the consistency or stability with which a research instrument measures what it intends to measure.

Validity refers to how accurate the measures used by the researcher are; for instance, the precision of data when analysing results and how applicable the findings are. Kumar (2011) describes the different types of validity that could be applied in quantitative research:

- Face and content validity are easy to apply to one's research, as each question listed in the research instrument are linked to objectives. The creation of that link is referred to as "face validity". Content validity refers to assessing the list of questions in the instrument.
- Concurrent validity refers to how well an instrument compares to another assessment performed in parallel.
- Predictive validity looks at the extent to which an instrument can predict an outcome.
- Construct validity is a sophisticated validity technique, as it is based on statistical procedures. Construct validity is determined by establishing the value of each construct in relation to the total variance observed in the phenomenon. Mukherjee (2019) adds that construct validity is created through the use of accurate design and data collection tools.

Based on Kumar's (2011) explanation and the following factors, the researcher has adopted face and content validity:

- All the questions formulated in the questionnaire were mapped to the main research question and sub-questions as indicated in Table 3.5.
- Mapping ensured alignment to the overall objective and ensured the appropriateness of the questions listed in the questionnaire.
- The questions assessed what the study aimed to investigate.

3.10 Ethical Considerations

Mukherjee (2019) indicates the importance of obtaining ethical consent from participants when conducting research, as it maintains confidentiality and avoids violation of participants' privacy during data collection. Mukherjee (2019) further mentions that the entire research process ought to incorporate ethical considerations. Therefore, the researcher has made use of a consent form (see Appendix B) which clearly stipulates the following elements:

- The purpose of the study
- The involvement of each participant
- The purpose for which the information is collected
- An indication of how privacy will be protected in the publication of the study

In addition, the researcher has obtained ethical clearance from the Department of Applied Information Systems at the University of Johannesburg on 27 August 2020 to conduct the research (see Appendix C).

3.11 Conclusion

Chapter 3 outlined the multi-layered research process undertaken by the researcher. In doing so, aspects such as the philosophical stance, sampling, data collection techniques and data instruments were discussed in detail. This chapter also discussed an instrumental aspect in the research process referred to as "ethical considerations" which sought to guide the researcher on what had been deemed ethical conduct. In addition, the researcher adopted a quantitative orientation and therefore aimed to maintain an unbiased and objective stance on what was being studied.

The next chapter provides the findings and analyse the data in detail. The data assists the researcher in understanding how AI is likely to shape activities performed by CAs.

CHAPTER 4: ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

The importance of analysing data lies in the ability to facilitate comparisons as well as identify relationships that exist within the data (Kothari, 2004). Kothari's (2004) view on data analysis outlines the objectives of this chapter which are to present and discuss the research findings. This chapter also summarises the key research findings which are fundamental for the discussion that will follow in Chapter 5.

4.2 Data Interpretation and Discussion

Personal information such as names, surnames and contact details were not requested, as the demographic profile of the respondents was not necessary for this study. The study received an 89% response rate, as 35 responses were targeted and a total of 31 responded over a period of six weeks. Respondents answered all the questions in the questionnaire, resulting in all 31 responses being eligible.

Therefore, all 31 responses are analysed in detail throughout this chapter. Research findings are presented in graphs and charts which have been generated using Microsoft Excel.

4.3 Descriptive Statistics

Figure 4.1 provides an insightful basis for this study, using a 100% stacked bar illustrating the respondents' job tenure within the firm along with their number of years as qualified CAs.

As seen in Figure 4.1, 48% of the respondents have been with the firm for one to five years. Twenty-six percent (26%) of the respondents indicated that they had been with the firm for six to ten years. Thirteen percent (13%) of the respondents indicated that they had been with the firm for 11 to 15 years. Six percent of the respondents indicated that they had been with the firm for 16 to 20 years and six percent added that they had been with the firm for over 25 years.

In addition, 52% of the respondents indicated that they had been qualified CAs for one to five years. Nineteen percent (19%) of the respondents indicated that they had been qualified CAs for six to ten years. Thirteen percent (13%) of the respondents indicated

that they had been qualified CAs for 11 to 15 years. Ten percent (10%) of the respondents indicated that they had been qualified CAs for 16 to 20 years. Six percent of the respondents indicated that they had been qualified CAs for 21 to 25 years.

These findings reveal that the majority of respondents to the questionnaire are young professionals with regard to certification and job tenure.

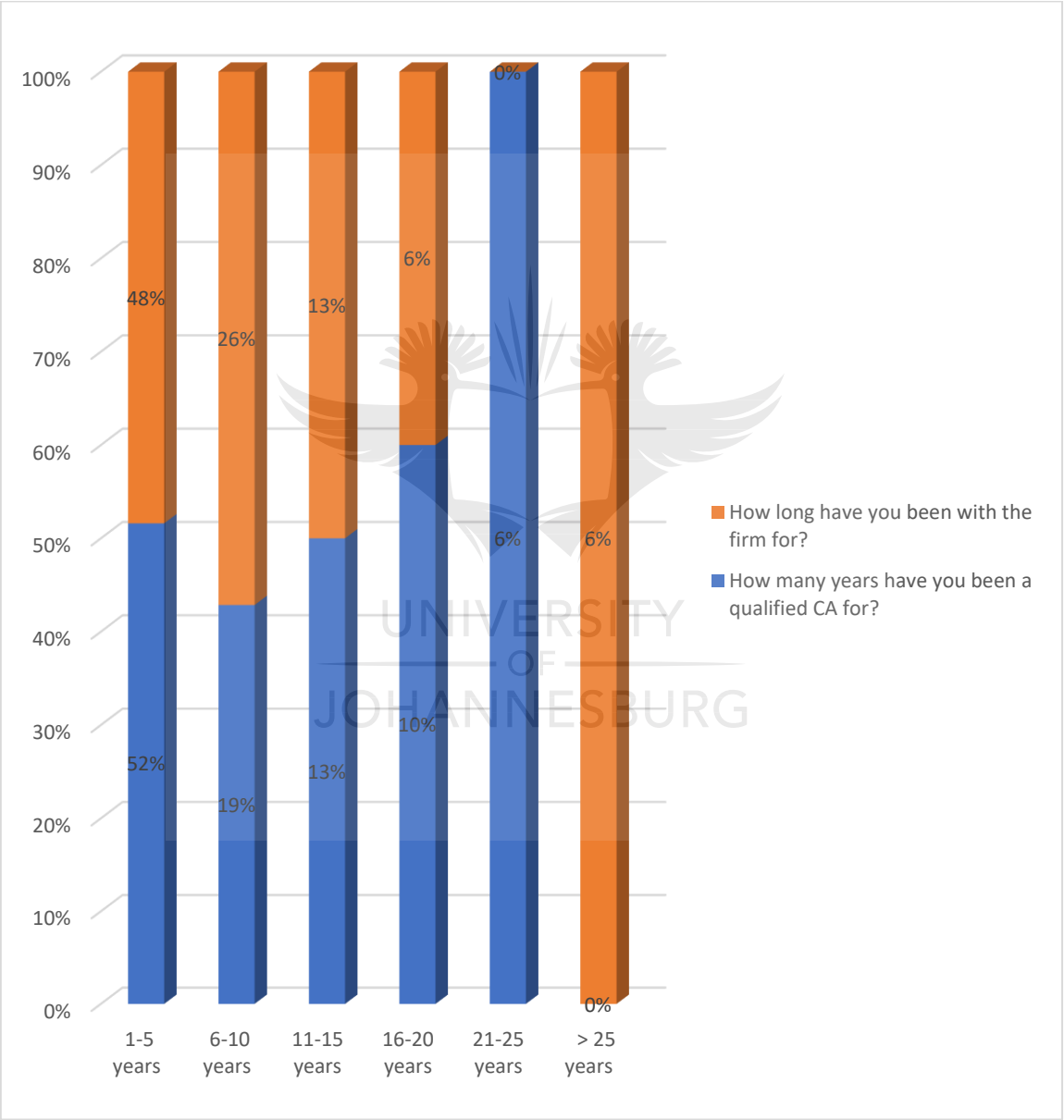

Figure 4.1: Respondents certification and job tenure

Respondents were asked if they believed that there was a probability that the CA profession would transition in the 4IR. Figure 4.2 illustrates that a large percentage of respondents (61%) believe that there is a high probability that 4IR will influence the chartered accountancy profession. This is followed by 32% of the respondents who believe that the 4IR will somewhat influence the CA profession while 6% provide a balanced (neutral) view.

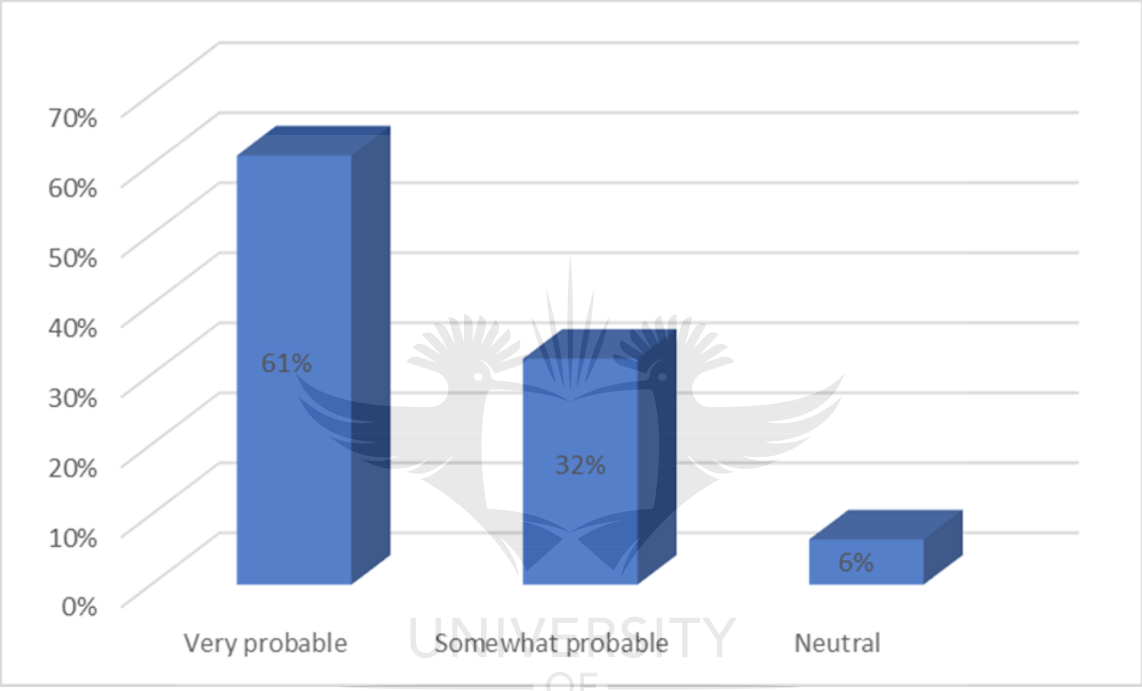

Figure 4.2: Respondents' view on 4IR influencing the chartered accountancy profession

Hussain, Aleksander, Smith, Barros, Chrisley and Cutsuridis (2018) define *awareness* as a concept that focuses on one's internal state such as intuitive feeling or external events by means of sensory perception.

Figure 4.3 below illustrates respondents' awareness of AI. Forty-two percent (42%) of the respondents indicated that they were extremely aware of AI, while 52% indicated that they were moderately aware of AI. In addition, six percent of the respondents indicated that were somewhat aware of AI.

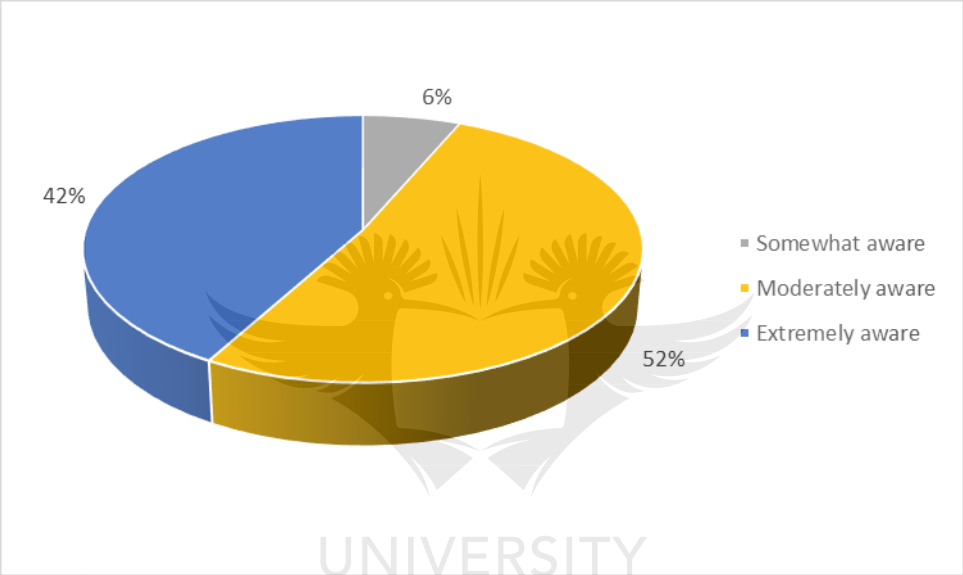

Figure 4.3: Respondents' awareness of AI

Figure 4.4 below indicates how knowledgeable these respondents are regarding AI. The term *knowledgeable* refers to a person who possesses knowledge of a certain topic (Merriam-Webster dictionary, 2020). Only ten percent of the respondents indicated that they were very knowledgeable while 42% indicated that they were knowledgeable. Forty-eight percent (48%) indicated that they were somewhat knowledgeable about AI.

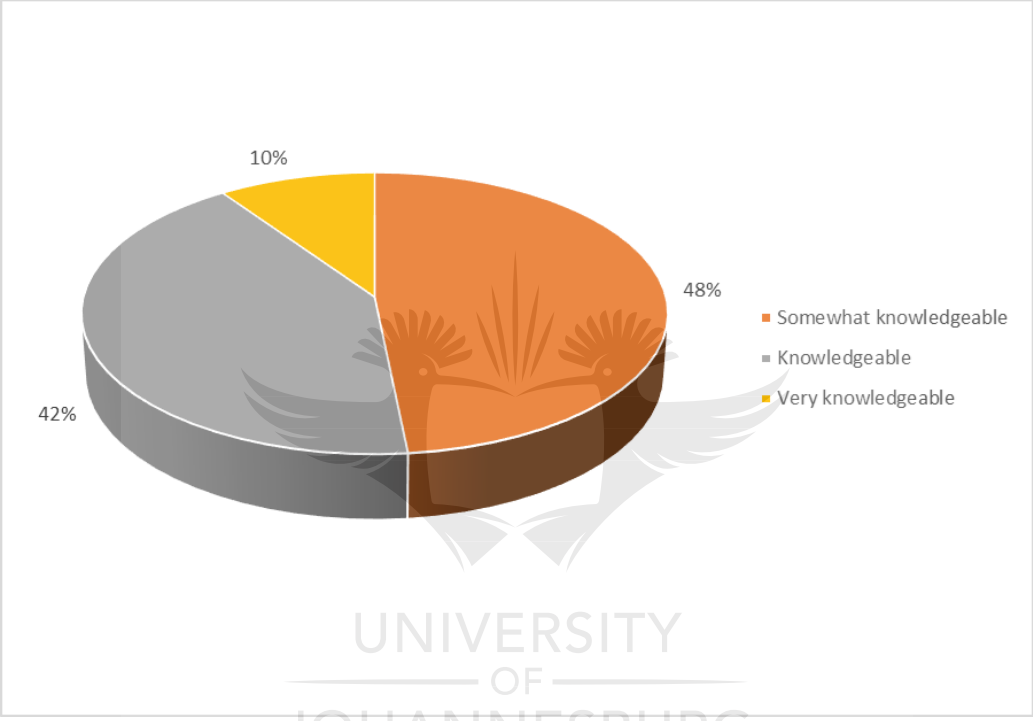

Figure 4.4: Knowledgeable about AI

Figure 4.5 below provides an inclusive view of the respondents' awareness and knowledge of AI using the weighted average scoring method of descriptive statistical analysis.

The weighted average scoring method assisted the researcher in providing a general consensus on respondent's views on awareness and knowledge of AI. The options on the Likert scale for awareness of AI were as follows: 1=Not at all aware, 2=Slightly aware, 3= Somewhat aware, 4=Moderately aware and 5=Extremely aware. The researcher multiplied the number of responses by the weight (135), then divide the total response rate, which was 155 , resulting to 87%. The options on the Likert scale for knowledge of AI were as follows:1=Not knowledgeable, 2=Somewhat knowledgeable, 3=Knowledgeable and 4=Very knowledgeable. The researcher multiplied the number of responses by the weight (72), then divide by the total response rate, which was 155, resulting to 46%.

Figure 4.5 illustrates that, while 87% of the respondents are aware of AI, only 46% are knowledgeable. This indicates that 54% of the respondents are not knowledgeable about AI and therefore incorporating AI into their individual development plans is essential. This research finding indicates that there is a need to equip these respondents with knowledge about AI, as AI is able to carry out mundane processes and subsequently free individual's time enabling them to focus on other areas (Anderson, 2019). Therefore, one can conclude that AI has the potential to optimise and streamline some activities that a human being would typically perform. This would increase the turnaround time and allow humans to focus on key areas.

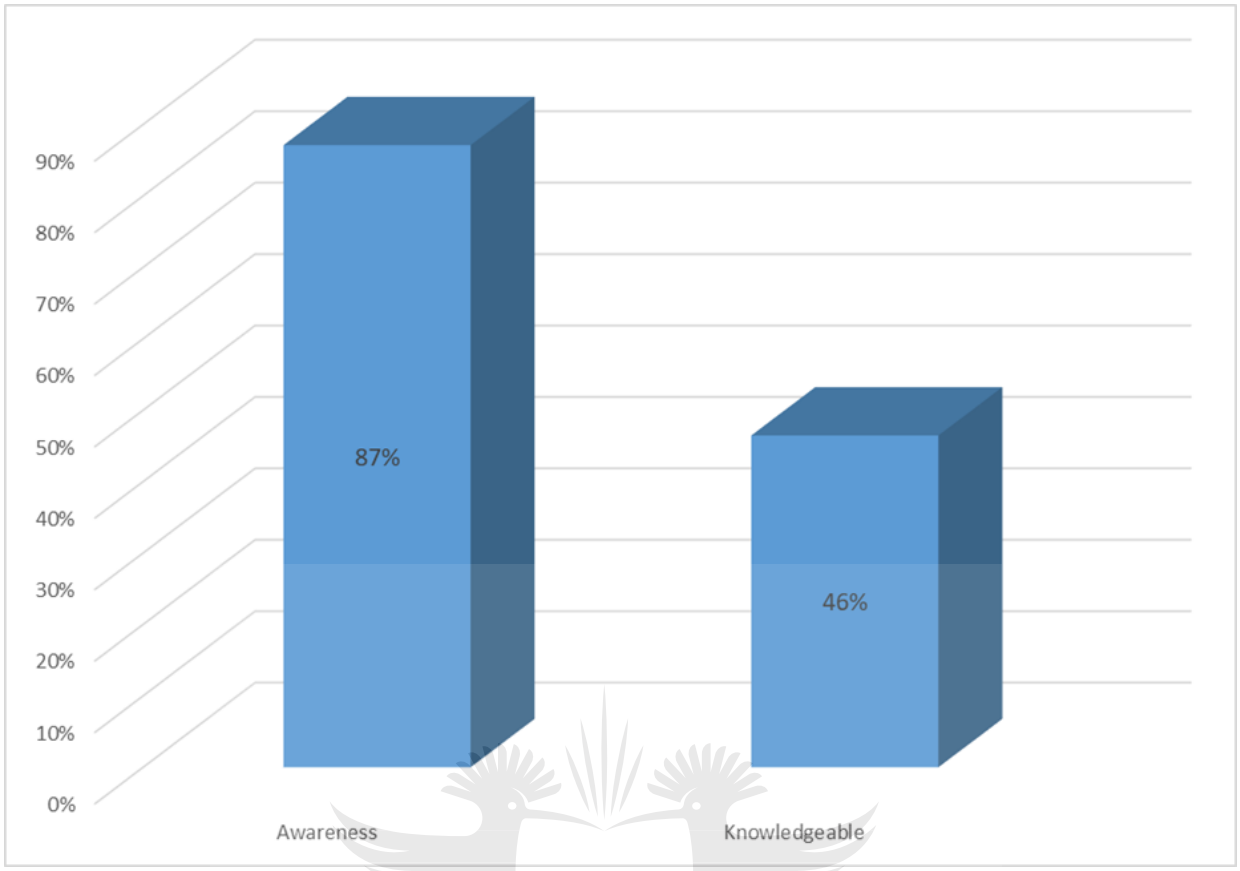

Figure 4.5: Awareness and knowledge of AI

Respondents were asked to select which of the chartered accountancy competencies would be impacted by AI.

Figure 4.6 indicates that 40% of the respondents stated that strategy, risk management and governance would be most impacted by AI. Thirty-eight percent (38%) indicated that management decision making and control would be the second most impacted chartered accountancy competency. Thirty-one percent (31%) indicated that financial management would be the third most impacted chartered accountancy competency. Thirty percent (30%) indicated that auditing and assurance would be the fourth most impacted chartered accountancy competency. Twenty-seven percent (27%) indicated that accounting and external reporting would be the fifth most impacted chartered accountancy competency.

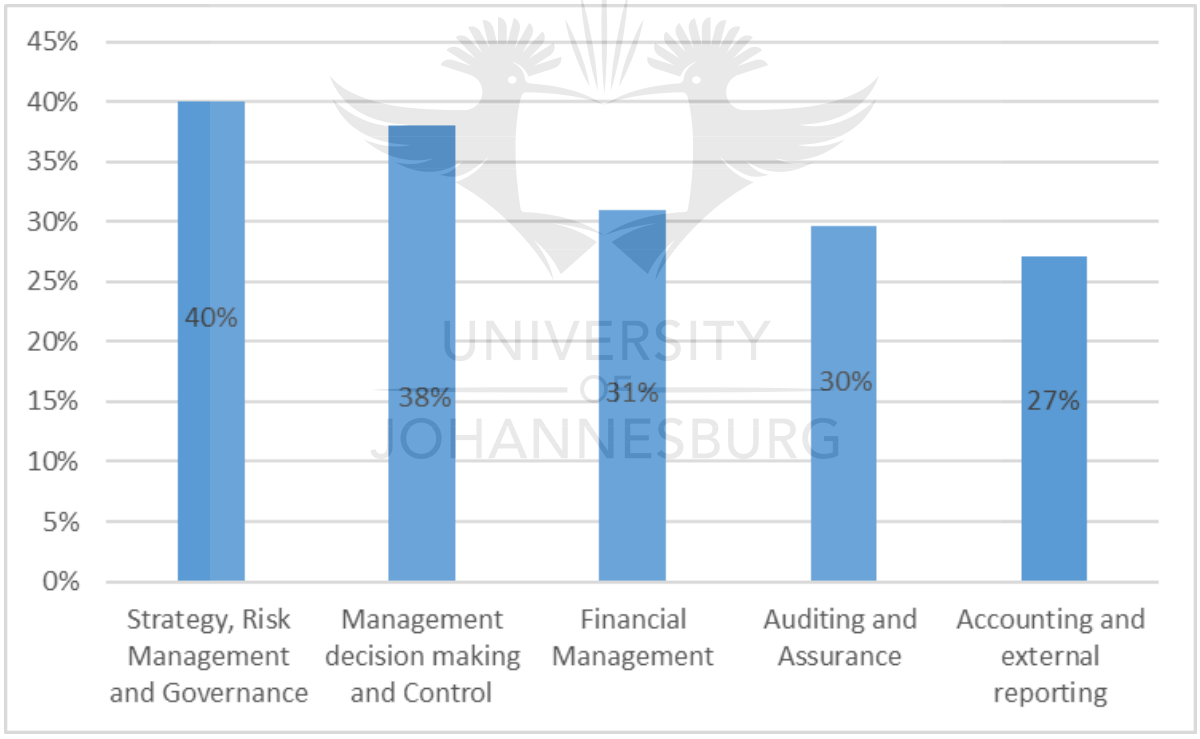

Figure 4.6: Respondents' view on the impact that AI will have on chartered accountancy competencies

Respondents were asked which AI advantages were desirable to them.

Figure 4.7 indicates that 87% of the respondents indicated that the decline in online fraudulent activities was the most desirable AI advantage. Eighty-five percent (85%) of the respondents indicated that the increase in data security was the second most desirable advantage, while 83% of the respondents indicated that the increase in turnaround time was the third most desirable advantage. Seventy-six percent (76%) of the respondents indicated that the ability to solve complex problem(s) was the fourth most desirable advantage and 75% of the respondents indicated that rational decision making was the fifth desirable advantage of AI.

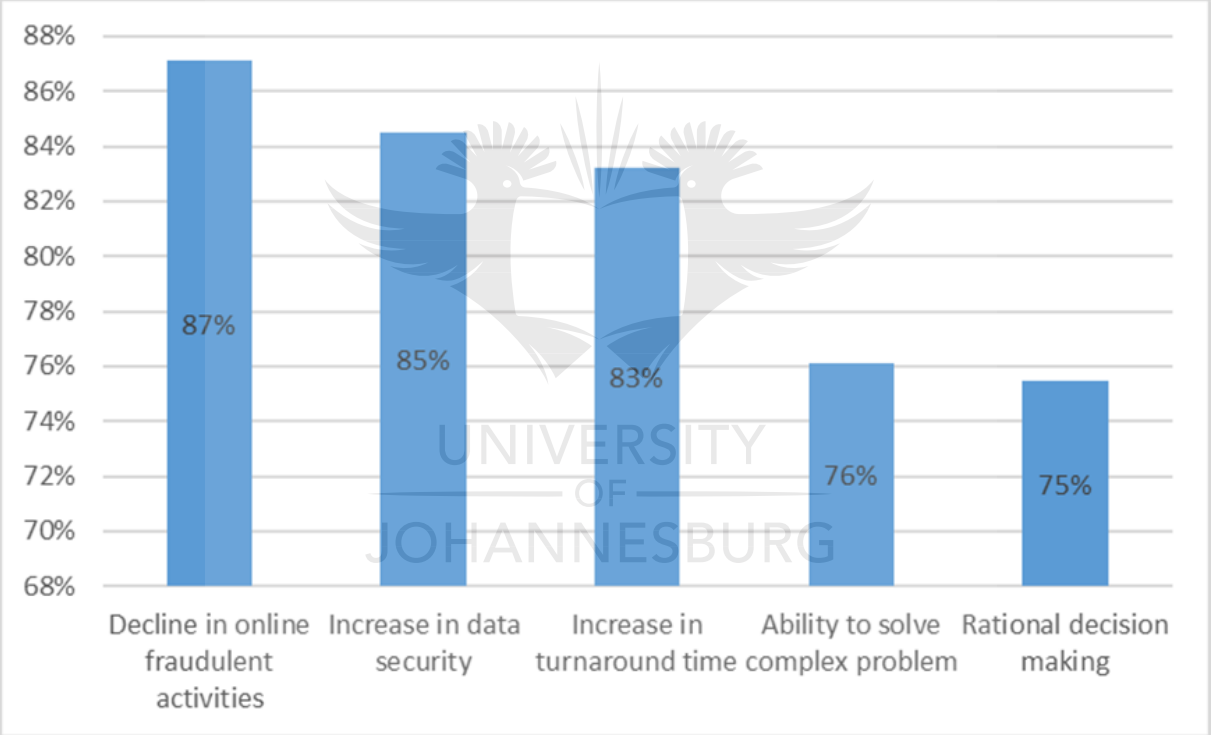

Figure 4.7: Respondents' interest in AI advantages

Respondents were asked about which of the AI disadvantages they were more concerned, as well as which of these disadvantages posed a potential threat to CAs within the firm.

Figure 4.8 indicates that 77% of the respondents indicated that they were concerned about the risk of a breakdown and loss of data. Sixty-nine percent (69%) of the respondents indicated that the risk of a breakdown and loss of data were potential threats to CAs within the firm. A total of 77% of the respondents indicated that the malfunction resulting in AI providing wrong solutions was the second highest concern, with 69% of the respondents indicating that the malfunction resulting in AI providing wrong solutions posed a potential threat to CAs within the firm. More than 72% of the respondents indicated that they were concerned about ethical and privacy concerns. This was the third highest concern among the CAs. Sixty-six percent of the respondents indicated that ethical and privacy concerns posed potential threats to CAs within the firm.

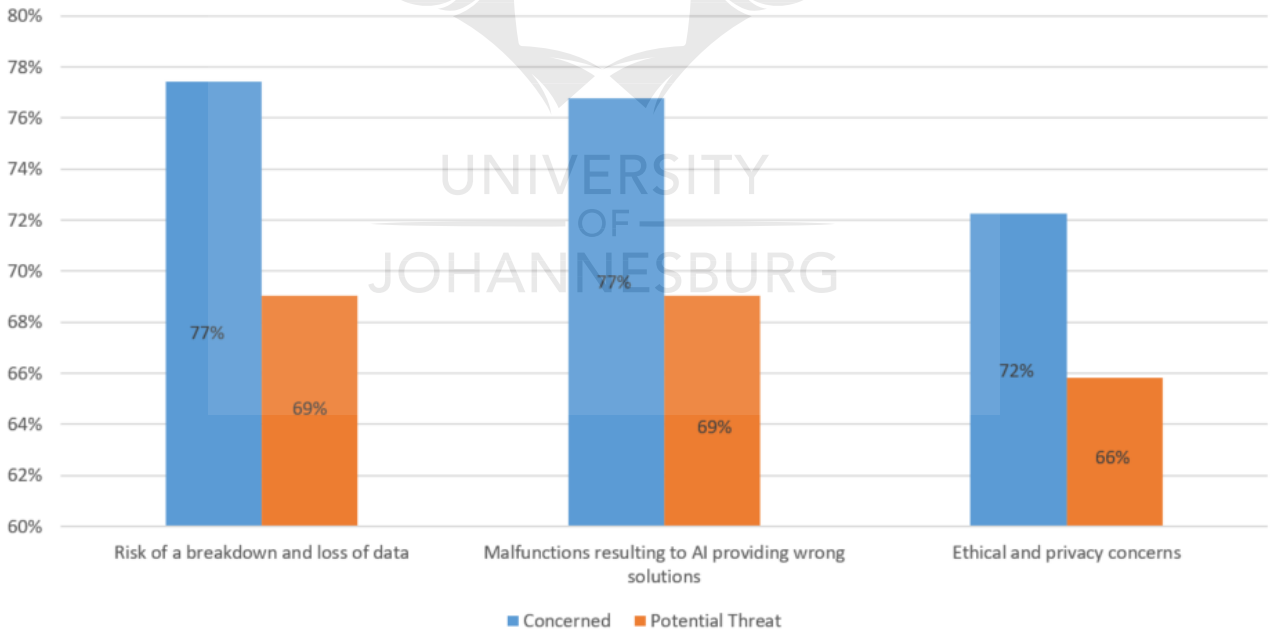

Figure 4.8: Concern vs. Potential threat

Figure 4.9 indicates that a large percentage of the respondents strongly believe that it is important for CAs to up-skill themselves with AI skills in order to keep abreast of the changes 4IR is likely to bring. This is as 77% of the respondents indicated that it was very important, while 16% indicated that it was moderately important. Three percent of the respondents indicated both slightly important and neutral.

AI applications facilitate decision making by providing decision makers with better data and informative new business insights. This indicates that CAs will benefit from AI applications, as they will be able to focus on other tasks (Robert, 2019).

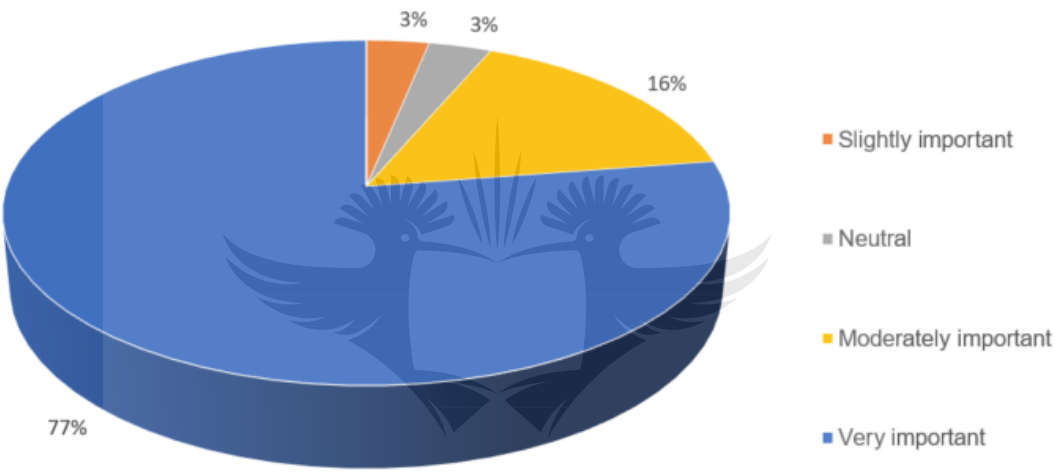

Figure 4.9: Importance to up-skill CAs

Respondents were asked which of these skills would effectively assist them with their overall deliverables.

Figure 4.10 indicates that 88% of the respondents indicated that Big Data Analysis would be the most effective skill. Sixty-three percent (63%) of the respondents indicated that cyber security would be the second most effective skill, while 62% of the respondents indicated that robotic process automation would be the third most effective skill. Fifty-two percent (52%) of the respondents indicated that Python for Accounting and Finance Professional was the fourth most effective skill to acquire.

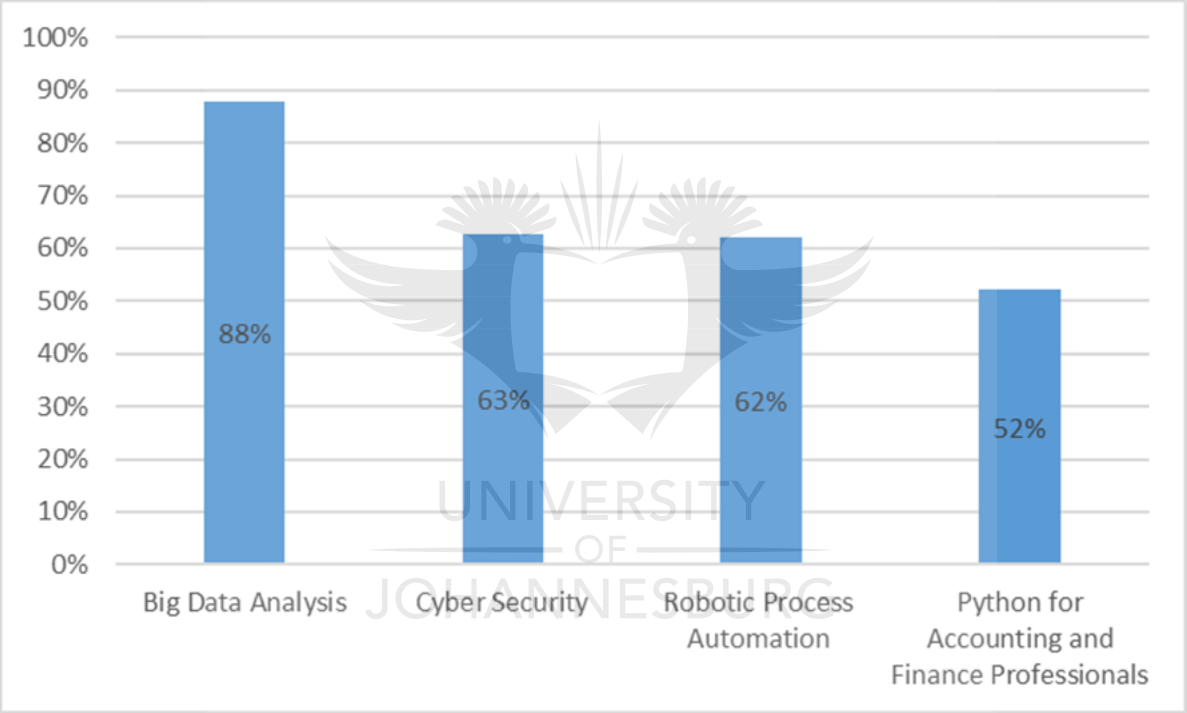

Figure 4.10: Respondents' view on effective skills

Respondents were asked of which of the four trends they were aware, as well as which of these trends should be incorporated into their individual development plans (IDPs).

Figure 4.11 indicates that 86% of the respondents indicated that they were aware of cyber security while 42% indicated that cyber security should be incorporated into their IDP. Seventy-four percent (74%) of the respondents indicated that they were aware of the Big Data Analysis while 41% indicated that the Big Data Analysis should be incorporated into their IDPs. Seventy-two percent (72%) of the respondents indicated that they were aware of robotic process automation while 45% indicated that robotic process automation should be incorporated into their IDPs. The results found that only 43% of the total respondents were aware of Python for accounting. However, 51% of the respondents indicated that there is a need to incorporate Python for accounting in their IDP.

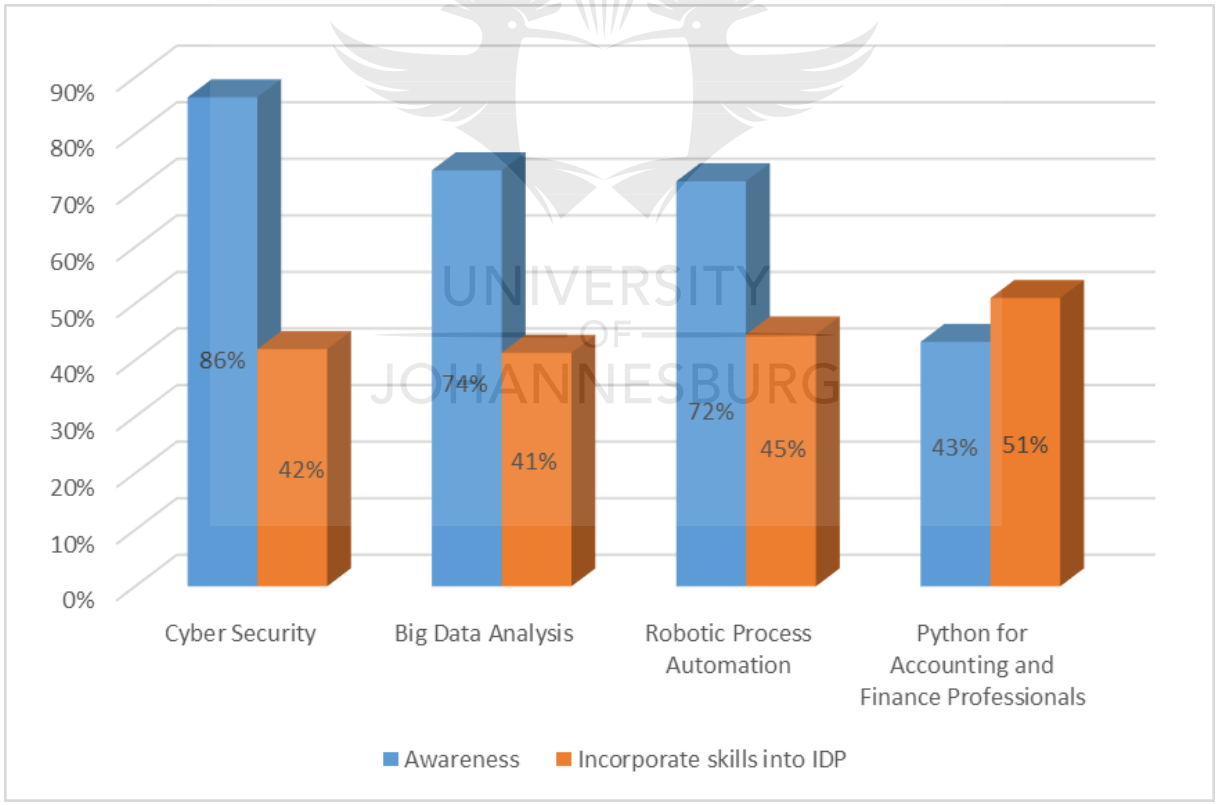

Figure 4.11: Awareness vs. IDP

4.4 Conclusion

Research findings were analysed and discussed in this chapter, and the following key findings presented:

- The majority of participants are young professionals with regard to certification and job tenure. Forty-eight percent (48%) of the participants had been with the firm for one to five years. It revealed that 52% of the participants had been qualified CAs for 1-5 years.
- Figure 4.2 provides preliminary insight into respondents' view on the influence that 4IR will have on the chartered accountancy profession. Figure 4.6, however, provides an interesting analysis of the impact that AI will have on chartered accountancy competencies. This research finding indicates that participants believe that AI will impact all chartered accountancy competencies to various degrees. The researcher attributes these diverse views based on the significance that each competency plays in ensuring that CAs perform their activities successfully.
- Seventy-seven percent (77%) of the participants indicated that there was a need for CAs to up-skill themselves with AI skills. The researcher attributes this research finding to Anderson's (2019) study that indicates the potential of AI lies in its ability to optimise and streamline some activities.
- Participants expressed the desire that they would like to incorporate the following courses into their short-term individual development plan (IDP) goals:
    - Big Data Analysis
    - Cyber security
    - Robotic process automation
    - Python for Accounting and Finance Professionals

In conclusion the research findings are fundamental for the discussion that follows in Chapter 5 where the research problem is revisited and concluded.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter 5 provides an overview on this study by covering the following areas:

- Revisiting the main research question and the sub-questions as detailed in Chapter 1 in order to provide answers based on the research findings and the literature
- Providing recommendations based on the research findings as detailed in Chapter 4
- Specifying the limitations which are inherent in this research
- Proposing areas for future research

5.2 Overview of this Study

The main research question aims to determine what the effect of AI will be within the chartered accountancy discipline specially looking at the skills and competency perspective of AI. Seven sub-questions were formulated to address the main research question.

5.2.1 Research sub-question 1

This question aimed to identify the general chartered accountancy skills and competencies of other professional bodies both African and international. This research question was answered through literature as indicated in Table 2.1. Literature revealed that the Institute of Singapore Chartered Accountants, Chartered Accountants Ireland, the South African Institute of Chartered Accountants and the Institute of Chartered Accountants of Zimbabwe comprised of the following general chartered accountancy skills and competencies. All candidates are required to possess the following skills and competencies before joining the profession:

- Pervasive skills
    - Ethics and professionalism
    - Personal attributes
    - Professional skills

- Chartered accountancy competencies
    - Strategy, risk management and governance
    - Accounting and external reporting
    - Auditing and assurance
    - Financial management
    - Management decision making and control
    - Taxation

5.2.2 Research sub-question 2

This question aimed to investigate how skills and competencies in the South African context differed from other African and international chartered accountancy skills and competencies. This research question was answered through literature as indicated in Table 2.1. Literature revealed that the skills and competencies in the South African context did not differ from those of the Institute of Chartered Accountants of Zimbabwe and the Chartered Accountants Ireland. However, the South African skills and competencies differed slightly from the Institute of Singapore Chartered Accountants, as apart from the general skills and competencies, the Institute of Singapore Chartered Accountants framework also included the following competencies:

- Agile finance
    - Big data analysis
    - Cyber security
    - Financial technology
- Digital awareness
    - Introduction to Python for Accounting and Finance Professionals
    - Robotic process automation and its impact on finance professionals
    - Transforming finance through intelligent automation
    - Regulations: RegTech and digital risk with learning journey

In conclusion, the Institute of Singapore Chartered Accountants is the only chartered accountancy professional body of the four that is currently addressing 4IR issues such as AI, cyber security and automation.

5.2.3 Research sub-question 3

This question aimed to investigate the advantages and disadvantages of AI in the chartered accountancy profession.

This research question was answered through literature as it revealed that the advantages of AI in the chartered accountancy profession are as follows: the ability to solve complex problems, increase in data security and turnaround time as well as a decline in online fraudulent activities. AI also facilitates rational decision making (Borana, 2016; Manyika et al., 2017; Plunkett, 2020; Shubhendu & Vijay, 2013). The research findings supported the literature.

The researcher ranked the responses based on how desirable these AI advantages were to the respondents. Each of the following advantages received more than 74%: the decline in online fraudulent activities, an increase in data security and turnaround time, an ability to solve complex problems and rational decision making.

In addition, literature revealed that the disadvantages of AI in the chartered accountancy profession were that there were ethical and privacy concerns, malfunctions resulting in AI providing wrong solutions and the risk of a breakdown and subsequent loss of data (Borana, 2016; Manyika et al., 2017; Plunkett, 2020; Shubhendu & Vijay, 2013). The research findings supported the literature.

The researcher ranked the responses based on how concerned the respondents were about the AI disadvantages. Each of the following disadvantages received more than 72%: risk of a breakdown in and loss of data, malfunctions resulting in AI providing wrong solutions as well as ethical and privacy concerns.

5.2.4 Research sub-question 4

This question aimed to investigate how the disadvantages of AI would pose threats to CAs within the firm. This research question was answered through research findings. The researcher found that respondents were concerned about the risk of breakdown and loss of data, malfunctions resulting in AI providing wrong solutions and ethical

privacy concerns would pose threats to CAs within the firm. Each of the potential threats received more than 65%.

5.2.5 Research sub-question 5

This question aimed to investigate how knowledgeable CAs within the firm were regarding AI.

This research question was answered through research findings. The researcher found that respondents were somewhat knowledgeable about AI. To determine the extent to which the respondents were knowledgeable about AI, the researcher compared the respondents' awareness to their knowledge. The findings revealed that only 46% of the respondents were knowledgeable about AI, while the majority (54%) of the respondents were not knowledgeable about AI.

5.2.6 Research sub-question 6

This question aimed to investigate the skills that CAs needed to acquire in order to keep abreast of the changes that AI would bring.

This research question was answered through literature as it revealed that the Institute of Singapore Chartered Accountants indicated that skills regarding big data analysis, cyber security, Python for Accounting and Finance Professionals and robotic process automation were required of CAs to keep abreast of future AI changes.

To confirm this view, the researcher firstly established to what extent the respondents believed that CAs would need to up-skill themselves regarding AI. The researcher found that 77% of the respondents indicated that it was very important for CAs to up-skill themselves for AI.

The researcher further aimed to establish to what extent these skills would be effective in CAs' overall deliverables. The research findings supported the literature. The researcher ranked the skills in order of importance as being big data analysis, followed by cyber security, then robotic process automation and lastly, Python for Accounting and Finance Professionals. Each of these skills received more than 51%.

5.2.7 Research sub-question 7

This question aimed to investigate how CAs in the firm perceived the prospective CA skills in terms of awareness and effectiveness.

This research question was answered through research findings, as it revealed that 86% of the respondents were aware of cyber security. Seventy-four percent (74%) of the respondents were aware of the Big Data Analysis. Seventy-two percent (72%) of the respondents were aware of robotic process automation. Forty-three (43%) percent of the respondents were aware of Python for accounting.

The research findings revealed that 88% of the respondents indicated that Big Data Analysis would be the most effective skill. Sixty-three percent (63%) of the respondents indicated that cyber security would be the second most effective skill, while 62% of the respondents indicated that robotic process automation would be the third most effective skill. Fifty-two percent (52%) of the respondents indicated that Python for Accounting and Finance Professional was the fourth most effective skill to acquire.

The researcher further aimed to established which of the skills they believed should be incorporated in their short-term IDP goals. This finding supported the literature, as the researcher found that the skills in Python for Accounting and Finance Professionals, robotic process automation, cyber security and big data analysis should be incorporated in CAs short-term IDP goals, listed according to their ranking. The higher ranking of Python for Accounting and Finance Professionals was attributed to the 43% awareness of this skill. This implied that, because the respondents' awareness was relatively low, they identified the need to up-skill themselves in that area.

5.3 Recommendations

This section provides recommendations based on the research findings in order to assist the audit firm.

CAs should up-skill themselves with regard to AI because only 46% of the respondents indicated that they were knowledgeable about AI.

The firm should further analyse how AI will impact the chartered accountancy competencies within the firm, and work with SAICA to identify if they have any plans for incorporating AI into their skills and competencies framework. The reason is that the respondents indicated (see Figure 4.6) that AI would impact the following chartered accountancy competencies:

- Strategy, risk management and governance
- Management decision making and control
- Financial management
- Auditing and assurance
- Accounting and external reporting

Given that a large percentage (61%) of the participants believed that there was a high probability that 4IR would influence the chartered accountancy profession, the firm should consider incorporating various courses in the short-term IDP goals of the CAs (see Figure 4.11). Big data analysis is very necessary, as it is able to optimise the organisation's operations to better understand their customers and markets. The big data analytics tools enable organisations to exploit real-time data so as to elevate their business models. Real-time data helps CAs improve their predictions on future outcomes which will assist organisations with their planning (Institute of Chartered Accountants England and Wales (ICAEW), 2019).

Cyber security is the second most important skill CAs need, this is as cyber-attacks threaten the use of an organisation's networks and systems, and subsequently it threatens the organisation's reputation (Haapamäki & Sihvonen, 2019). Cyber security is therefore important, given the work that CAs perform.

The Python for Accounting and Finance Professionals package is important, since it provides users with flexibility and allows them to deal with larger data sets. This skill is essential to the work that CAs perform.

Robotic process automation is also a necessary skill for CAs to acquire, since adopting RPA software is beneficial with repetitive tasks completed by CAs. It will subsequently decrease processing time and improve accuracy (Cooper, Holderness, Sorensen & Wood, 2018).

Once CAs are knowledgeable about these skills, the firm needs to look into tailoring its business processes and service offerings to assist them in increasing their revenue when billing clients based on the new skills set the CAs would have acquired. Secondly, once CAs are fully trained in these skills, it will result in higher efficiency due to a decrease in the turnaround times.

5.4 Limitations of this Study

This section indicates factors that limit this study and are inherent to this research. Homogenous sampling contributed to ensuring that all respondents shared a common basis in terms of qualifications and work experience. In addition, this sampling method ensured that the researcher is able to verify respondents that fit the sampling criteria. This study does not provide a holistic representation of the chartered accountancy profession within this particular firm, as questionnaires were distributed to only a limited number of CAs across the firm. This resulted in a limited scope of study. Broadening the scope to all the big four auditing firms in South Africa would improve this study and provide a general view of the chartered accountancy profession, in a South African context.

5.5 Future Research

In order to provide a holistic view of the impact that AI will have in the chartered accountancy profession, items that could be considered for future research are to broaden the research by including other audit firms, conduct more analyses among the respective audit firms and to increase the number of unit analyses. Examining all the professional bodies and frameworks that fall under CAW as listed in section 2.2, would assist in ensuring that CAW continues to provide excellence in the chartered accountancy profession worldwide. This would also provide a comprehensive analysis on the fundamental similarities and differences between developed and developing nations. This would also assist in identifying areas of potential improvement within the chartered accountancy profession.

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APPENDIX A: CA COMPETENCIES

	Strategy, Risk Management and Governance
II-1	**The creation and comparison of an entity's strategy thus providing recommendations on areas of improvement**
1.1.	Examine if management choices reflect the entities mission and vision
1.2.	Understand and compare external attributes that affect the progress of an entity's strategy
1.3.	Understand and compare internal attributes that affect the progress of an entity's strategy
1.4.	Understand and assess if the business model aligns to entity's vision, mission and objective
1.5.	Recognize potential risk and opportunities that emerge from the entity's strategy
1.6.	Comprehend the IT strategy
II-2	**Assess entity's risk management plan**
2.1.	Understand the entity's processes and framework in place for risk management
2.2.	Assess the entity's programme in place
2.3.	Find the entity's risk recourse activities
II-3	**Assess the governance models in place for entity's**
3.1.	Understand the relevance of preparation with regards to governance
3.2.	Assess the entity's governance layout

3.3.	Understand the processes that are in place
3.4.	Find and assess the role that the audit and risk committee play in governance
3.5.	Find and assess the roles that the internal audit function plays in governance
	Accounting and external reporting
III-1	**Assess monetary reporting needs and create required systems**
1.1	Find an applicable framework
1.2.	Study the needs for financial reporting
1.3.	Create and assess reporting processes that enable financial reporting
1.4.	Creates consistent and accurate information
1.5.	Optimise financial reporting through the use of IT
III-2	**Perform financial reporting externally**
2.1.	Create or assess accounting policies that align to IFRS
2.2.	Reports on the entity's daily transactions
2.3.	Reports on entity's non-routine transactions
2.4.	Utilize IFRS to compile financial statements
2.5.	Create or assess financial statements note disclosure
2.6.	Elaborate on the financial statements and balances to stakeholders
2.7.	Consider the key ideas and principles when proposing financial reporting standard changes
III-3	**Perform customised reporting**
3.1.	Finds and analyse detailed reporting duties

3.2.	Finds governing and other filing duties
3.3.	Identifies and assess the need for non-financial reporting
3.4.	Perform internal and external non-fiscal reporting
	Auditing and Assurance
IV-1	**Assess and provide guidance on assurance needs**
IV-2	**Offer assurance services**
2.1	Identifies and considers the issues pertaining to accepting an engagement
2.2	Adheres to the methods in place when accepting an engagement
2.3.	Establishes the criteria to incorporate to the issue being evaluated
2.4.	Evaluate if the engagement will happen
2.5.	Find and evaluate the risks associated in achieving the engagement
2.6.	Create procedures that are effective in relation to the scope of the engagement along with the evaluated risks
2.7.	Carriers out the work plan
2.8.	Record work carried out along with its outcome
2.9.	Assess the results and provide a conclusion
2.10.	Document a report once the engagement has been carried out
2.11.	Assimilate information for stakeholders
IV-3	**Provide control-related services**
3.1.	Recognise and assess risks associated to the financial information system(s)
3.2.	Assess entity's financial information system(s) along with related checks

IV-4	**Create, execute and manage the entity's quality control system**
IV-5	**Recognise and reply to reporting irregularities**
	Financial Management
V-1	**Create or assess total financial goals**
1.1.	Understands financial goals
1.2.	Understand the way in which the entity is legally structured
1.3.	Identify the manner in which ownership can be updated
V-2	**Assess the value of an enterprise**
2.1.	Assess the enterprises current monetary stance whilst considering factors that may influence the enterprise in the future
2.2.	Assess the suitability and influence of growth strategies those created and utilised by the enterprise
2.3.	Forecast the value of the entity
2.4.	Assess a planned merger or acquisition
V-3	**Plan and monitor the financing of an enterprise**
3.1.	Track cash flow
3.2.	Assess the working capital of the entity
3.3.	Recognise and assess money sources
3.4.	Assess the decisions made in relation to the allocation of profits
3.5.	Assess both the entity's cost of capital and capital structure
V-4	**Financial risk management as part of a risk management policy for an entity**

4.1.	Create and assess policies in place for managing risks in relation to financial risks
4.2.	Compare the use of by-products
V-5	**Create or assess business plans along with financial offers**
V-6	**Evaluate capital investment opportunities**
6.1.	Assess the investment decision
6.2.	Assess other options of asset specific finance
6.3	Consider required issues pertaining to structure and compliance
V-7	**Identify or provide guidance to business that are financially challenged**
	Management decision making and Control
VI-1	**Recognise and assess elements that impact an entity's financial performance**
1.1.	Recognise the needs that management has
1.2.	Assess the layout of the entity's accountability system
1.3.	Assesses the entity's financial achievement and provide recommendations on areas of improvement
VI-2	**Handle entity's budgeting process and control system**
2.1.	Creates, assesses and monitors financial budgets
2.2.	Assesses and interprets budget discrepancies
2.3.	Looks into the application of an ordinary costing system and does a comprehensive variance analysis
2.4.	Looks into the application of cost management methods

2.5.	Assesses contracting methods
VI-3	**Assess the entity's cost allocation and transfer-pricing options**
3.1.	Assesses transfer-pricing options between functional divisions
3.2.	Assess cost-assignment alternatives for service departments
VI-4	**Assesses financial and other data used to require information to assist in decision making**
4.1.	Establishes and assesses financial information needed for decision making
4.2.	Establishes and assesses aspects which business decisions are prone to uncertainty
4.3.	Establishes and articulates the importance of qualitative elements which influence the decision
VI-5	**Recognizes, creates and improves applicable costing systems to meet information requirements regarding the enterprises processes in place for control and decision-making**
5.1.	Recognises applicable costing systems as well as governs applicable allocation of costs
5.2.	Creates and optimises on the appropriate IT infrastructure required to produce information
	Taxation
VII-1	**Assess taxpayer's tax profile along with finding generic tax matters**
1.1.	Understand taxpayers tax profile
VII-2	**Formulates tax calculations and provide guidance on tax matters**
2.1.	Formulates ordinary tax

2.2.	Formulates VAT
2.3.	Formulates wealth taxes
2.4.	Formulates alternative taxes regarding the Income Tax Act
2.5.	Finds and deliberates on detailed tax planning opportunities for taxpayers
2.6.	Finds and deliberates on the penalties related to specific corporate transactions
2.7.	Incorporates anti-avoidance regulation
2.8.	Incorporates and understands tax regulation through applying specific choices of the courts
VII-3	**Performs effective tax administration**
3.1.	Recognise mandatory requirements pertaining to governance and filling
3.2.	Define mandatory administrative requirements
3.3.	Compiles material for governance as well as reacts to administrative requirements
3.4.	Assess and reply to SARS enquiries and

APPENDIX B: CONSENT FORM AND QUESTIONNAIRE

Dear Participant,

Thank you for taking the time to participate in this study. This project aims to understand the impact of Artificial Intelligence on the Chartered Accountancy profession, towards the fulfilment of a master's degree. To this end, the researcher wishes to collect data to determine the possible effect that Artificial intelligence is likely to have on Chartered Accountants in the firm. If you are a Chartered Accountant within the firm, you are invited to participate in this study.

Please take note of the following:

- This questionnaire is expected to take 10-15 minutes to complete
- Completing the questionnaire is voluntary
- You may discontinue with this questionnaire at any point without adverse consequences
- Your identity will not be revealed and used in any publication(s)
- No personal questions or identifying particulars will be asked in this questionnaire
- All information obtained in this questionnaire will be kept in utmost confidentiality and will be used only for academic purposes
- Only the researcher involved in the project will have access to the raw data
- The dataset may possibly be utilised in future research, the same confidentiality will be applied in that instance
- If you have any concerns or questions related to the study in general, or the items in the questionnaire please contact the researcher via e-mail fdenge@yahoo.com or telephonically on (+27)72 2419 125
- Feedback will be provided electronically

Kind Regards,

Miss Fulufhelo Denge

+27722419125

fdenge@yahoo.com

An Artificial intelligence model to enhance the Chartered Accountancy Profession

The purpose of this questionnaire is to determine the possible effect that Artificial intelligence is likely to have on Chartered Accountants in the firm.

Question 1: How many years have you been a qualified CA for?

- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- > 25 years

Question 2: How long have you been with the firm for?

- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- > 25 years

Question 3 : Do you believe that there is a probability that the CA profession will transition in the fourth industrial revolution (4IR)?

- Not probable
- Somewhat improbable
- Neutral
- Somewhat probable
- Very probable

Question 4 : Are you aware of Artificial Intelligence (AI)?

- Not at all aware
- Slightly aware
- Somewhat aware
- Moderately aware
- Extremely aware

Question 5 : Are you knowledgeable about AI?

- Not knowledgeable
- Somewhat knowledgeable
- Knowledgeable
- Very knowledgeable

Question 6: To what extent will AI have an impact on the following CA Competencies ?

	To a Great extent	Somewh at	Very Little	Not at All
Strategy, Risk Management and Governance	○	○	○	○
Accounting and external reporting	○	○	○	○
Auditing and Assurance	○	○	○	○
Financial Management	○	○	○	○
Management decision making and Control	○	○	○	○
Taxation	○	○	○	○

Question 7: How desirable are the following AI advantages to you?

	Very undesirable	Undesirable	Neutral	Desirable	Very desirable
Ability to solve complex problems	○	○	○	○	○
Increase in data security	○	○	○	○	○
Decline in online fraudulent activities	○	○	○	○	○
Increase in turnaround time	○	○	○	○	○
Rational decision making	○	○	○	○	○

Question 8: How concerned are you on the following AI disadvantages ?

	Not at all concerned	Slightly concerned	Somewhat concerned	Moderately concerned	Extremely concerned
Ethical and privacy concerns	○	○	○	○	○
Malfunctions resulting to AI providing	○	○	○	○	○

wrong solutions					
Risk of a breakdown and loss of data	○	○	○	○	○

Question 9: Of the listed AI disadvantages which are you most concerned will pose as potential threat to CA's within the firm?

	Not at all concerned	Slightly concerned	Somewhat concerned	Moderately concerned	Extremely concerned
Ethical and privacy concerns	○	○	○	○	○
Malfunctions resulting to AI providing wrong solutions	○	○	○	○	○
Risk of a breakdown and loss of data	○	○	○	○	○

Question 10 : Do you believe that it is important for CA's to upskill themselves with AI skills in order to keep abreast with the changes that 4IR will bring?

- ○ Low importance
- ○ Slightly important
- ○ Neutral
- ○ Moderately important
- ○ Very important

Question 11: Are you aware of ?

	Not at all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
Big Data Analysis	○	○	○	○	○
Cyber Security	○	○	○	○	○
Python for Accounting and Finance Professionals	○	○	○	○	○
Robotic Process Automation	○	○	○	○	○

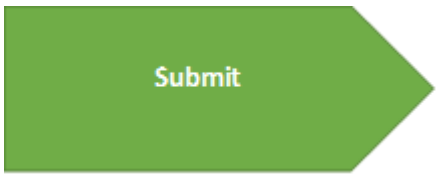
Question 12: Do you believe that these skills will effectively assist with your overall deliverables?

	Very ineffective	Ineffective	Average	Effective	Very effective
Big Data Analysis	○	○	○	○	○
Cyber Security	○	○	○	○	○
Python for Accounting and Finance Professionals	○	○	○	○	○
Robotic Process Automation	○	○	○	○	○

Question 13: Do you agree that these skills should be incorporated to your short term Individual Development Plan (IDP) goals?

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Big Data Analysis	○	○	○	○	○
Cyber Security	○	○	○	○	○
Python for Accounting and Finance Professionals	○	○	○	○	○
Robotic Process Automation	○	○	○	○	○

Thank you for your interest and assistance with this research.



APPENDIX C: ETHICAL CLEARNACE

UNIVERSITY OF JOHANNESBURG

CBE RESEARCH ETHICS COMMITTEE

Dear Researcher/s

ETHICAL APPROVAL GRANTED FOR RESEARCH PROJECT

Decision: Clearance granted

This letter serves to confirm that that the proposed research project indicated in the table below, has been reviewed by the Department of Applied Information Systems at the University of Johannesburg. Ethical clearance is hereby granted and is valid for three years, from 27 August 2020 until 26 August 2023.

Applicant	Fulufhelo Denge
Supervisor	Prof Carl Marnewick Dr Wikus Erasmus
Student/staff number	200824772
Title	An Artificial intelligence model for enhancing the Chartered Accountancy Profession
Decision date at meeting	27 Aug 2020
Reviewers	AIS REC members
Ethical clearance code	2020AIS064
Rating of application	Code 02

CODE 01 - Approved

CODE 02 - Approved with suggestions/ requirements with no re-submission

CODE 03 - Referred back

CODE 04 - Disapproved, cannot re-submit

The researcher/s may now commence with the study providing that:

1. The researcher/s will ensure that the project adheres to ethical research requirements
2. The researcher/s will be conducting the study as set out in the approval application
3. The researcher/s will ensure that project adheres to all applicable legislation, scopes of practice, professional codes of conduct and scientific standards as it pertains to the field or study.
4. The researcher/s will bring under the attention of the research ethics committee any proposed changes, concerns that arise, and unexpected ethical management issues