EXAMINING HOW ACCOUNTING IS INFLUENCED BY INDUSTRY 4.0 IN KWAZULU NATAL, SOUTH AFRICA.

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Abstract

The study aimed to examine how accounting is influenced by Industry 4.0 in KwaZulu-Natal, South Africa. Grounded in the interpretivism paradigm and a phenomenology research design, the study aimed to gain a deeper understanding of accounting firms' response to the implementation of Industry 4.0. The target population were accountants in KwaZulu Natal. A sample size of 13 accounting executives participated and completed the study. Data for the study was collected through in-depth telephone interviews with the purposively selected participants who were accounting executives. The qualitative data from the interviews were analysed using thematic analysis. The study findings show the dearth of academic research on Industry 4.0 in the accounting sector in South Africa. The findings reflected that accounting firms have a history of being hesitant to adopt modern and innovative technologies and as a result, their practices are increasingly incompatible with the expectations of their clients who may prefer the flexibility and speed brought by Industry 4.0. The findings indicate further that Industry 4.0 is influencing how financial statements are prepared, presented, stored, and communicated to stakeholders. In addition, the study revealed that Industry 4.0 enabled financial information to be collected and processed in real-time which supports effective and efficient decision-making. The study found that resistance to change, lack of skilled staff and organisation's resources present a challenge to Industry 4.0 technology adoption. Findings showed that it's the responsibility of firm leadership to create the vision, plan and communicate to communicate the Industry 4.0 vision and goals to all stakeholders. The study found that cybersecurity breaches have severe economic and reputation implications for accounting firms. In addition, the findings revealed that management experience stress when dealing with the aftermath of a cybersecurity breach. The study recommends that accounting firms consider investing in cyber insurance policies to lessen the costs associated with cybersecurity breaches. Universities and other institutions of higher learning must consider introducing data analytics and advanced accounting systems in the accounting curriculum. The study further recommends that businesses periodically back up their data and have safeguards in place to secure client information. Findings from this study can inform policy, research,

and practice in South Africa's accounting sector in terms of Industry 4.0 adoption.

Accounting practices, Change management, Cyberattack, Cybersecurity risk, Data breaches, Industry 4.0.

DECLARATION

I Alexander Markey Oluka declare that:

- The research reported in this thesis, except where otherwise indicated, is my original work.
- This thesis has not been submitted for any degree or examination at any other university.
- This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
- This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers.

Sign

DEDICATION

To my late wife Nondumiso Adorable Oluka.

ACKNOWLEDGEMENTS

To my family and friends who helped and encouraged me to walk this journey to this stage.

I give special thanks to Professor Abdulla Kader for guiding me through the whole process.

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KEY WORDS

Accounting practices, Change management, Cyberattack, Cybersecurity risk, Data breaches, Employees skills, Industry 4.0, Leadership, Resources, Social media.

Table of Contents

CHAPTER 1. INTRODUCTION TO THE STUDY 1
1.1 Introduction 1
1.2 Background of the study 2
1.2.1 Accounting technology 4
1.2.2 Overview of accounting in South Africa 9
1.3 Research gaps 13
1.4 Statement of the problem 13
1.5 Aim of the study 15
1.6 Research objectives 15
1.7 Research questions 15
1.8 Significance of the study 16
1.9 Contribution of the study 16
1.10 Structure of the study 17
1.11 Conclusion 18
CHAPTER 2. LITERATURE REVIEW 19
2.1 Introduction 19
2.2 Part A: Theoretical framework 19
2.2.1 Introduction 19
2.3 Institutional theory 20
2.4 Technology organisational and environmental framework (TOE) 25
2.4.1 The technological context 27
2.4.2 The organisational context 30
2.4.3 Environment context 32
2.5 Conclusion of the theoretical framework 34
2.5.1 Accounting in business 35
2.6 Evolution of the industrial revolution 38
2.7 Industry 4.0 components with respective literature 42

2.7.1 Introduction 42
2.7.2 Cyber-physical systems (CPS) 42
2.7.3 Cloud Systems 46
2.7.4 Machine to machine (M2M) communication 51
2.7.5 Artificial intelligence (AI) 54
2.7.6 Smart factories 58
2.7.7 Internet of things 63
2.7.8 Data mining 66
2.8 Literature review part B 70
2.8.1 The influence of Industry 4.0 on accounting 70
2.8.2 Opportunities presented by Industry 4.0 in accounting 75
2.8.3 The role of management in implementing Industry 4.0 in accounting business 86
2.9 Literature review part C 93
2.9.1 Factors that influence accounting firms to adopt Industry 4.0 technology 93
2.9.2 Cybersecurity risks associated with Industry 4.0 implementation in accounting 98
2.10 Conclusion 120
CHAPTER 3. RESEARCH METHODOLOGY 122
3.1 Introduction 122
3.2 Research design 122
3.3 Ontology 123
3.4 Epistemology 124
3.5 Research paradigms 125
3.5.1 Interpretivism research paradigm 125
3.6 Research strategy 127
3.6.1 Phenomenological research 127

3.7 Data collection 132
3.7.1 Observation 132
3.7.2 Focus group 133
3.7.3 Archival research 134
3.7.4 Interviews as data collection tool adopted by this study 135
3.8 Criteria for recruiting participants. 146
3.9 Target population 147
3.10 Sampling 149
3.10.1 Sampling strategy 149
3.11 Sample size 153
3.12 Trustworthiness of the study 154
3.13 Data analysis 159
3.13.1 Thematic analysis 159
3.14 Ethical consideration 161
3.15 Conclusion 164
CHAPTER 4. PRESENTATION AND DISCUSSION OF FINDINGS-THEME-ONE 165
4.1 Introduction 165
4.2 Part A: Demographic information 165
4.3 Theme one: the influence and opportunities of Industry 4.0 in accounting 167
4.3.1 Sub-theme 1: Emergence of Industry 4.0 influence on accounting practicesI 169
4.3.2 Sub-theme 2: Primary Industry 4.0 factors influencing accountants to adopt new technology. 201
4.3.3 Sub-theme 3: Opportunities presented by Industry 4.0 in accounting. 221
4.4 Conclusion 235
CHAPTER 5. PRESENTION AND DISCUSSION OF FINDINGS-THEME TWO237
5.1 Introduction 237

5.2 Theme two: the challenges and risks associated with the adoption of Industry 4.0 in accounting 237
5.2.1 Sub-theme 1: Challenges presented by Industry 4.0 238
5.2.2 Sub-theme 2: Cybersecurity risks and breaches 251
5.2.3 5.2.3 Sub-theme 3: Implications of breaches on firms 258
5.2.4 Sub-theme 4: Implications of breaches on management-leadership .. 272
5.3 Conclusion 277
CHAPTER 6. PRESENTATION AND DISCUSSION OF FINDINGS-THEME THREE 278
6.1 Introduction 278
6.2 Theme three: the role of management in implementing Industry 4.0 and the responses of accounting firms to cybersecurity risks. 278
6.2.1 Sub-theme 1: Management role in implementing Industry 4.0 technologies 280
6.2.2 Sub-theme 2: Responding and recovery to cyber security breaches.. 295
6.3 Conclusion 309
CHAPTER 7. CONCLUSION AND RECOMMENDATION 313
7.1 Introduction 313
7.2 Conclusion of the study 313
7.2.1 Objective 1. To examine how accounting is influenced by Industry 4.0 in KwaZulu Natal. 313
7.2.2 Objective 2. To establish the opportunities and challenges presented by Industry 4.0 in the accounting sector in KwaZulu Natal. 314
7.2.3 Objective 3. To investigate the role of management in implementing Industry 4.0 in accounting firms in KwaZulu Natal 314
7.2.4 Objective 4. To determine the factors influencing accountants to implement Industry 4.0 in KwaZulu Natal 315
7.2.5 Objective 5. To examine cybersecurity risks associated with Industry 4.0 implementation in accounting. 315

7.3 Recommendations of the study 316
7.3.1 Recommendation 1: Teaching analytics and systems at universities . 316
7.3.2 Recommendation 2: Additional hiring and training 316
7.3.3 Recommendation 3: Cyber insurance 317
7.3.4 Recommendation 4: Communication..... 317
7.3.5 Recommendation 5: Risks of implementing Industry 4.0. 317
7.3.6 Recommendation 6: Integrating new and old systems 318
7.4 Limitations of the study 318
7.5 Future research area..... 319
7.6 Implications of the study..... 320
7.7 Conclusion 321

REFRENCE LIST……320

LIST OF TABLES

Table 1. 1 List of accounting organisations in South Africa 10
Table 2. 1 Smart factories and their effects on accounting..... 60

LIST OF FIGURES

Figure 1. 1 Structure of the study. .....**Error! Bookmark not defined.**
Figure 2. 1 Theoretical framework..... 34
Figure 2. 2 Smart factories 59
Figure 4. 1 Racial distribution of participants..... 165
Figure 4. 2 Gender distribution of participants..... 165
Figure 4. 3 Age distribution of participants 166
Figure 4. 4 Years of Experience of participants..... 166
Figure 4. 5 Education level of participants..... 167
Figure 4. 6 Cluster analysis..... 168
Figure 4. 7 Hierarchy Charts 168
Figure 5. 1 Word cloud..... 237
Figure 5. 2 Cluster analysis..... 238
Figure 6. 1 Word tree 278
Figure 6. 2 Word cloud..... 279
Figure 6. 3 A conceptual framework for the successful implementation of Industry 4.0 in accounting. 310

CHAPTER 1. INTRODUCTION TO THE STUDY

1.1 Introduction

The digital era has arrived, and its impact is felt across spheres of life. Technological advancements are forcing organisations to change the way they do business and the way they serve customers, and accounting is not exempted from technological disruption. Global economic factors have been and will continue to be profoundly affected by the advent of Industry 4.0. Industry 4.0, sometimes called Fourth Industrial Revolution, has attracted attention worldwide over the last few years. The implementation of Industry 4.0 related innovations will undoubtedly have an impact on employment and productivity. However, adopting Industry 4.0 technologies requires organisation leadership to rethink the company's whole management model in respect to all stakeholders in the ecosystem in which it operates. This implies that managers should carefully craft their strategy for Industry 4.0 taking into account all relevant factors.

The accounting profession has witnessed significant technological advancements, from the introduction of the printing press to the emergence of computerised systems. The advent of computers revolutionised accounting practices, enabling businesses to capture transactions electronically. Today, the proliferation of Industry 4.0 technologies is transforming the accounting profession further, altering how financial information is presented, transmitted, and analysed. The digital transformation of the accounting industry is a multifaceted process that involves the integration of new technologies, the evolution of accounting activities, and the development of new competencies among accounting professionals. As such, it is crucial for accounting education and training programs to keep pace with these changes and equip future accountants with the necessary skills and competencies to thrive in the digitalised accounting environment.

1.2 Background of the study

Automated systems powered by information and computer algorithms are the foundation of the industrial revolution, which is an extension of the third industrial revolution. Computer-generated design work and three-dimensional (3D) printing, which can produce solid structures by building up successive layers of materials, are now the fourth industrial revolution (Philbeck and Davis 2018). Industry 4.0 is characterised by a fusion of different technologies that blur the boundaries across the physical, biological, and digital domains (Schab 2016). The combination of physical, digital, and biological spheres with many new types of technologies can now interact intelligently (Skilton and Hovsepian 2018). Industry 4.0 is sometimes called the fourth industrial revolution and is used interchangeably in this study.

Industry 4.0 is a multidisciplinary concept that influences many disciplines. However, there is still no general understanding of what makes up an industrial revolution (Maynard 2015). Moreover, there have been a number of definitions in the literature focused on diverse topics, but few of them have put management at the forefront (Piccarozzi, Aquilani and Gatti 2018). This study defines Industry 4.0 as a holistic system of information technologies, people, machines, and tools, which allows the flow of goods, services and data in a controlled way, through the value chain, with operations with a high degree of autonomy and high capacity to transmit useful information to decision-making (Dombrowski and Wagner 2014; Hermann, Pentek and Otto 2016; Mazak and Huemer 2015).

Salkin *et al*. (2018) suggest that Industry 4.0 is synonymous with the creation of communicative and intelligent systems that interact between humans to machine and machine to machine. This is facilitated by Cyber-Physical Systems (CPS) that are made up of smart devices, storage systems, and manufacturing facilities that can communicate directly, trigger activities, and autonomously control one another (Hermann, Pentek and Otto 2015). A cyber-physical system is a multi-process system that combines communication, physical processes, and computation (Wang and Wang 2016). The Internet of Things (IoT) network allows CPS to communicate with one another using unique addressing patterns. The integration of the real and virtual worlds is a fundamental feature of Industry 4.0

(Kagermann 2014). Industry 4.0 is built on the vertical and horizontal integration of manufacturing systems, which is enabled through real-time data exchange and flexible manufacturing (Li, Hou and Wu 2017; Thoben, Wiesner and Wuest 2017).

Industry 4.0 enables real-time control, integrated maintenance, improved adaptability, more collaboration across the supply chain, improved monitoring capabilities, smarter products, new business models, and customer-centric manufacturing (Koca 2018). It envisions that each physical object (for example, machines, components, or final product) is fitted with built-in digital technology that enables other objects and humans to interact (Pozdnyakova *et al.* 2019). Having real-time data available at separate places also helps with strategy and process design (Nagy *et al.* 2018). That is, the transaction is performed promptly and in real-time, ensuring that the outcome is instantly available. The massive amounts of data generated by smart devices enable the organisation to better understand its customer's needs and the specific tasks required to meet them (Saucedo-Martínez *et al.* 2018).

To maximise the influence of Industry 4.0, it is critical to have a clear digital strategy in place and to consistently implement it (Oesterreich and Teuteberg 2016). The primary impediment to implementing Industry 4.0 is an absence of a coherent digital strategy for value-creating processes (Stock and Seliger 2016). Digitalisation can lead to organisations prioritising technology over their consumers if they lack a clear strategy for implementing it (Schwertner 2017). Despite the lack of knowledge on digital strategy, research shows that companies must face the issue of making strategic decisions to implement digital technology (Legner *et al.* 2017). To achieve successful adoption of Industry 4.0, organisations must implement a digital strategy (Bharadwaj *et al.* 2013).

Grabowska *et al.* (2020) explain that Industry 4.0 encompasses not just technical advancements but also change in business model, strategic planning, and supply chain management. The profitability and competitiveness of a company are linked to the business models that it adopts (Ferasso *et al.* 2020). The creation of innovative business models will ensure fast process restructuring and agile production (Saniuk and Saniuk 2018). Creating a business model that can handle

the challenges posed by Industry 4.0 is essential because of the rapid growth of competition, which is mostly a result of globalisation (Grabowska and Saniuk 2022). A business model is connected to business operations and management. Business models are graphical representations of a business idea that include a collection of elements and their interactions (Porter 1996). Modern business models incorporate elements of both the virtual and physical worlds (Grabowska and Saniuk 2022).

1.2.1 Accounting technology

The greatest technological advancement that helped to quickly diffuse accounting concepts was Gutenberg's innovation of the printing press (Anandarajan *et al.* 2004). However, the emergence of the computer transformed accounting practices because businesses could then capture their transactions electronically (Anandarajan *et al.* 2004). In 1954, General Electric became the first company to employ computers in accounting to process payroll and tax calculations even though only a few accountants could use a computer at the time (Mason 2004). In addition, accounting software known as generalised audit software (GAS) was implemented for the first time in 1968 (Nwachukwu *et al.* 2021). One of the advantages of computers over humans is their ability to process vast volumes of information without the risk of error. Computers made it possible to present data at a level of depth previously unavailable to the earlier generation (Devine, Srinivasan and Zaman 2004). Computerised data can be utilised to improve control. For instance, assistance in detecting waste and fraudulent activities.

Modern technology has increased the importance of accounting as a technique of financial analysis and effective management, rather than just reporting financial data (Mancini, Vaassen and Dameri 2013). The adoption of computerised systems enabled tasks to be separated, allowing managers to use sophisticated ways for measuring performance and assigning goals for their employees (Turner, Weickgenannt and Copeland 2020). With this, accountants must now be familiar with both digital and manual systems.

Kurt (2019) suggests that one of the most important conditions for realising Industry 4.0 is the completion of digital transformations by businesses. Although

it is true that technology integration within the accounting profession is not necessarily a new force or trend, the embedded nature of new and emerging instruments has the capacity to redefine the entire accounting profession (Kurt 2019). There is a potential fundamental change in how information is reported, who receives this information, and what the result of this information is for end-users in tax reporting, auditing and advisory services (Schmitz and Leoni 2019). Therefore, it is imperative for management practitioners to know how to apply these technologies to maximise performance (Caruso 2016). Thus, workers must be trained in the emerging and latest technologies to remain competitive (Kaur, Tomar and Singh 2018).

Some careers and tasks may become redundant with the new industrial revolution, and new careers and roles may arise that require high knowledge and technology. Industry 4.0 is building the factories of the future where sensor networks and production lines are linked to each other, generating instant data, and so that software and algorithms can be transformed into instant reports within the system (Kurt 2019). The remote management method is capable of running smart factories, dark factories and the internet of things where humans are involved at least over the internet and where high productivity will be provided (Kablan 2020). This directly affects the vital role of the workforce which in today's production paradigm is the power of production which transforms labour relations well beyond the traditional industrial relations (Hoffman 2017).

The combination of data, sensors, and information is likely to eliminate unskilled labour (Davenport and Kirby 2015). The introduction of robots and machines that can replace the unqualified workforce will change the character and skills of the workforce and the number of jobs in each industry (Gotthardt *et al.* 2020). Although some accounting professionals may certainly lose their employment if they do not acquire new skills, it is best to think about the influence of Industry 4.0 in accounting in terms of the change on tasks that accountants perform rather than their jobs (Hoffman 2017). In this regard, it is important to meet the needs of the new century, the labour force needs to align itself and channel its potential into areas such as robotics and automation (Kurt 2019).

Accounting professionals are tasked with collecting and integrating data as a financial report that would be beneficial to all stakeholders. Traditionally, financial reports provide information based on historical evidence that is beneficial for stakeholders such as potential investors, suppliers, consumers and creditors to make decisions (Gepp *et al.* 2018). However, the emergence of Industry 4.0 is transforming how financial information is presented, transmitted, and analysed (Dai and Vasarhelyi 2017). Kaya and Akbulut (2018) note that while the structure of accounting and financial reporting seems the same, the implementation of big data analytics into accounting is transforming conventional tracking, data collection, and analysis methods.

Krahel and Titera (2015) claim that big data influence would lead to improvements in accounting standards and reporting standards. Warren, Moffitt and Brynes (2015) suggest that the quality of financial statements is expected to improve and become more transparent with the adoption of the Internet of Things and big data, and balance sheet items attain a standard on an international scale.

Accounting professionals working in the financial sectors of businesses will be profoundly affected by digitalisation in the future (Kablan 2020). It is expected that accounting professionals are likely to become system developers and reviewers of reports prepared by intelligent systems (Kablan 2020). In addition, Coyne, Coyne and Walker (2018) explained that future accounting professionals also need to deal with how to analyse the large amount of unstructured data that has to be recorded in the financial reports for accurate decision making. Thus, it will take specialisation to extract useful and meaningful information and to submit it correctly and promptly to the information users (Autor 2015). It is expected that an accounting professional must extract terabyte-sized financial data, analyse it, and make the results relevant to stakeholders (Erturan and Emre 2018). Therefore, accounting professionals in future are predicted to be system designers or system consultants (Hacioglu 2020).

Industry 4.0 is transforming the accounting profession to real-time accounting. With the aid of Industry 4.0, traditional accounting systems are predicted to become real-time accounting applications (Kablan 2020). The automated entry of data to the system and remote access may be provided along with the use of

the cloud accounting software, and accounting processes will be real-time (Yürekli and Şahiner 2017). One of the many notable advantages of Industry 4.0 is collecting, processing, and disseminating data in a timely, easily accessible and transparent manner (Gupta *et al.* 2017).

Slyyozka and Zahorodnya (2017) suggest that with Industry 4.0, the accounting profession is anticipated to be divided into creative and notary accounting. Notary accountants will perform duties regarding transactions and agreements that are beyond the scope of the accounting application, while creative accountants are responsible for evaluating a company's internal control, planning or managing operations that are outside formal accounting (Hacioglu 2020). With the proliferation of smart technologies, accountants must explore beyond the numbers in their work. Therefore, accounting professionals will be required to deliver more comprehensive corporate reporting that focuses less on the figures (Schaltegger and Burritt 2017).

The most significant advancement in accounting applications offered by Blockchain technology is seen as the transformation of the double-entry system into a triple-entry system, which is viewed as the unique function of the system (Faccia and Mosteanu 2019). Triple-entry accounting offers a more efficient technique to overcome underlying transparency and trust challenges inherent in traditional accounting systems (Cai 2021). Both accounts can use the third public ledger to ensure that all three records are correctly captured and recorded (Faccia and Mosteanu 2019). The asset's status change is automatically recorded in a shared ledger and made available to all parties involved (Cai 2021). Blockchain-based triple-entry accounting could be a game changer (Deloitte 2016). Blockchain can be a tamper-proof audit trail because of its consensus and encryption algorithm that ensure the integrity of transactions (Rozario and Vasarhelyi 2018).

Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network (Lohmer and Lasch 2020). It can be used to track virtual transactions thereby reducing risk and cutting costs for businesses. Triple-entry accounting is a theoretical concept proposed to enhance traditional double-entry accounting by adding a third entry

for each transaction (Faccia and Mosteanu 2019). Cryptographic receipt records the third entry on a Blockchain or other distributed ledger, providing an immutable and tamper-proof record of the transaction (Faccia and Mosteanu 2019). The three parties involved in each transaction are the buyer, the seller, and the network. The buyer and seller record the debit and credit entries in their respective accounting ledgers, and the network records the third entry in the Blockchain or distributed ledger. The Blockchain system provides an additional layer of security and transparency by creating an independent and verifiable record of every transaction that can be accessed by all parties involved (Saurabh, Rani and Upadhyay 2023). Blockchain provides a tamper-proof and immutable ledger that guarantees data integrity (Yang *et al*. 2023). Saurabh, Rani and Upadhyay (2023) indicate that triple-entry accounting provides a clear and transparent record of all transactions. In addition, Blockchain uses cryptography to secure transaction information, protecting against fraud and data breaches (Yang *et al*. 2023).

Faccia and Mosteanu (2019) explain that the difference between double-entry and triple-entry accounting is that triple-entry adds a third component known as the Cryptograph to the double-entry accounting. Blockchain technology links every element of a transaction and provides a tamper-proof record so that the transaction cannot be altered or deleted, thus reducing errors and fraud.

The advent of Industry 4.0 has brought about significant changes in accounting practices and financial reporting. The integration of Information Systems (IS) infrastructure and Business Intelligence and Analytics (BI and A) technologies has been instrumental in transforming accounting practices (Peters *et al*. 2022). Accounting practices such as planning, control, performance measurement, transaction processing, and reporting have been enhanced by these technologies, leading to improved decision-making by managers (Atkinson *et al*. 2022; Rikhardsson and Yigitbasioglu 2018).

The use of IS-enabled Strategic Enterprise Management (SEM) practices has been found to improve decision-making performance. These practices, enabled by strong IS applications based on BI and A technologies, facilitate multi-level managerial debate and reinforce performance aspirations (Peters *et al*. 2017).

The integration of IS infrastructure has been found to enhance management accounting tasks by providing timely and accurate information, ultimately improving strategic decisions (Appelbaum *et al*. 2022; Davenport *et al.* 2022; Peters *et al.* 2022).

Moreover, the alignment of IS infrastructure with IS-enabled SEM practices develops the ability for better management of accounting staff and executives to use emerging technologies, such as BI and A, to make better decisions (Peters *et al*. 2022). The study also highlights the importance of strategic flexibility in innovation. The ability to effectively and timely identify changes in the external environment depends on strong IS infrastructure integration associated with BI functionality to facilitate effective decision-making and timely response (Appelbaum *et al*. 2022). The advent of Industry 4.0 has brought about significant transformations in accounting practices and financial reporting. The integration of IS infrastructure and BI&A technologies has been instrumental in enhancing these practices, leading to improved decision-making and strategic flexibility in innovation.

1.2.2 Overview of accounting in South Africa

Accounting firms in South Africa provide tax services, accounting services, risk management consulting, and audit services. Forensic accounting, business valuation, financial planning, and information technology consulting are just some of the various services that audit firms are continually offering (Arens *et al.* 2017). Accounting professionals in South Africa play an essential role in the economy since they usually serve as decision-makers in businesses (Venter, Gordon and Street 2018). According to Venter, Gordon and Street (2018), accounting is a critical component of economic growth because of its essential function in producing financial data for making decisions. According to Soll (2014), accounting is expected to generate quality data that supports good financial decisions and effective capital allocation, resulting in a thriving society.

In South Africa, the entry into accounting profession is regulated by different accounting bodies. Accounting regulatory bodies establish qualification requirements for aspiring professional accountants seeking admission to the respective member organisations. Accounting regulatory organisations set

assessments that graduates must take after graduating from higher education institutions for them to qualify to practice as professional accountants. For example, to become a Chartered Accountant, graduates must pass an external assessment, known as the Initial test of Competence (ITC), set by the South African Institute of Chartered Accountants (SAICA). This requirement permeates across accounting regulatory organisations in South Africa. Venter and De Villiers (2013) suggest that accounting departments at South African universities are directly influenced by the SAICA.

When a business hires an unregistered accounting professional, the company has no legal remedy if the accountant gives reckless advice that is not in the interests of the public (Venter and De Villiers 2013). However, registered members of an accounting organisation can be sanctioned for violating the rules and policies of a given organisation (Barron, Schneible and Stevens 2018). Moreover, there has been a renewed emphasis on safeguarding public interest in the accounting profession following the recent scandals (Robinson 2018). In South Africa, professional accountants performing non-audit services are not bound by any statutory code outlining their responsibilities for the way in which these services are performed. However, the Auditing Professions Act No.26 of 2005 regulates the appointment of auditors in South Africa (RSA 2005).

Table 1. 1 List of accounting organisations in South Africa

Number	**Professional Accounting Organisations in South Africa**
1	South African Institute of Chartered Accountants (SAICA)
2	South African Institute of Professional Accountants (SAIPA)
3	Association of Chartered Certified Accountants (ACCA)
4	Chartered Institute for Business Management (CIBM)
5	Chartered Institute of Management Accountants (CIMA)
6	Institute of Accounting and Commerce (IAC)
7	Southern African Institute for Business Accountants (SAIBA)

8	The Institute of Certified Bookkeepers (ICB)
9	Institute of Internal Auditors South Africa (IIA)
10	The Southern African Institute of Government Auditors (SAIGA)
11	Association of Accounting Technicians (AAT)
12	South African Institute of Tax Professionals (SAIT)

The role of accountants is to make sure the data presented in the statements and reports is helpful to relevant stakeholders in decision-making (Saeidi, Prasad and Saremi 2015). The work of the accountant is constantly evolving and encompasses more than just the elementary compilation of financial statements and the conventional function of financial and management accounting (Dahal 2019). Changes in the business structure and digital disruption brought on by modern technologies are influencing several aspects of the corporate world, including the accounting profession (Birt *et al.* 2020). It is inevitable that accounting practices will change because of the proliferation of smart technologies and their influence on businesses.

Economic fluctuations can lead to unpredictable financial environments, making financial planning and forecasting difficult (Alexander 2018). South Africa's economic instability can pose significant challenges for accountants. For example, the recent social unrest and unreliably power supply has an impact on economic activity and the accounting profession. These issues have exacerbated the shortage of accountants in South Africa as skilled professionals are migrating to other countries. The lack of skilled accountants can lead to an increased workload for existing accountants and can impact the quality of financial reporting (Balwanz and Ngcwangu 2017).

The advent of new technologies such as artificial intelligence, Blockchain, and data analytics is transforming the accounting profession. While these technologies offer new opportunities, they also pose challenges. Accountants need to acquire new skills to use these technologies effectively. Moreover, technological advancement can lead to job insecurity due to the fear of

automation (Bhargava, Bester and Bolton 2021). The fear of automation could be related to the education and training of accountants in South Africa. These could be associated with the quality of education, access to education, and the relevance of the accounting curriculum (De Villiers 2021).

The accounting profession in South Africa is heavily regulated. Changes in regulations can pose challenges as accountants need to constantly update their knowledge and adapt their practices to comply with new rules (Fairbairn 2020). Moreover, accountants often face ethical dilemmas in their work. These dilemmas can be exacerbated in a challenging socio-economic environment. The Zondo Commission in the state of capture, Steinhoff Accounting scandal have revealed some of the ethical challenges accountant face in South Africa. Accountants need to navigate these ethical challenges while maintaining their professional integrity (Holtzblatt, Foltin and Tschakert 2020).

With the advent of Industry 4.0 technologies such as artificial intelligence (AI), machine learning (ML), and Blockchain, the accounting sector in South Africa can achieve greater efficiency and accuracy in their operations. Industry 4.0 technologies can automate routine tasks, reduce human errors, and provide real-time financial insights, thereby enhancing the overall efficiency of accounting operations (Davenport 2018). In addition, Industry 4.0 technologies can provide valuable real-time data and predictive analytics, which can significantly improve decision-making processes in the accounting sector. For instance, AI and ML can analyse vast amounts of financial data to identify trends, patterns, and anomalies, providing valuable insights for strategic decision-making (Brynjolfsson and McAfee 2018).

Blockchain technology, a key component of Industry 4.0, can revolutionise the South African accounting sector by providing a secure, transparent, and tamper-proof system for recording transactions. This can increase trust among stakeholders and ensure compliance with financial regulations (Tapscott and Tapscott 2017). Embracing Industry 4.0 can foster innovation and provide a competitive advantage for South African accounting firms. By leveraging these advanced technologies, accounting firms can offer new services, improve customer experiences, and differentiate themselves in the market (Schwab

2016). The advent of Industry 4.0 necessitates a shift in the skills required in the South African accounting sector. By embracing Industry 4.0 technologies, the accounting sector can address the skills gap and prepare the workforce for the future. This includes training and development in areas such as data analytics, cybersecurity, and digital literacy (Bessen 2019).

1.3 Research gaps

The empirical research examining the outcome of investing in Industry 4.0 is minimal despite its professed benefits (Cagle 2020). There is still limited research on the potential benefits and challenges that Blockchain can bring to the accounting and assurance areas (Dai and Vasarhelyi 2017; Bonsón and Bednárová 2019). More research is needed on the phenomena of Industry 4.0 and whether companies have understood digitalisation and are successfully taking advantage of its benefits (Kuusisto 2017).

Salkin *et al.* (2018) indicate that there are no clear evaluation methods and achievement measures for transforming to Industry 4.0. A survey by Goldstruck (2019) reveals that the rate of adoption of Industry 4.0 technologies by South African businesses is minimal, with only 13 percent implementing artificial intelligence within their operations.

A systematic and standardised roadmap for the implementation of Industry 4.0 is still not clear (Sarvari *et al.* 2018). Bytniewski, *et al.* (2020) indicate that the concept of Industry 4.0 is still evolving and requires further studies to understand the phenomenon. There is still a lack of systematic understanding of digital transformation at different levels of an organisation (Matt *et al.* 2015; Gray and Rumpe 2017). It is clear from these established research gaps that more research is required on Industry 4.0 to seek potential solutions to address the issues highlighted.

1.4 Statement of the problem

In the era of Industry 4.0, characterised by the integration of digital, physical, and biological systems, the accounting profession is confronted with a transformative shift. Historically, accounting has been a discipline slow to incorporate technological innovations, often adopting a "wait and see" attitude towards

modern technology (Ellison-Taylor 2019). This reluctance is further exacerbated by regulatory bodies lagging in their acceptance of modern technology (Dai and Vasarhelyi 2017), and a tax system that struggles to keep pace with the digital era's real-time transaction processing and analysis (Grant-Thornton 2018).

The emergence of Industry 4.0 is disrupting traditional accounting roles, processes, and procedures. The increasing role of robots in manufacturing and the introduction of virtual currency are altering financial statement entries. Furthermore, the assessment of intangible assets, such as Intellectual Capital, is likely to change asset disclosure in financial statements. The integration of big data analytics into accounting is transforming traditional recording techniques, data gathering, and analysis (Kaya and Akbulut 2018). Big data enables accountants to collect and report large volumes of structured and unstructured data in real-time. However, this technological shift also increases the risk of data breaches.

In South Africa, particularly in KwaZulu-Natal, the accounting profession is grappling with these global trends. A survey by Timmis (2019) found that 31 percent of South African small business owners do not believe they will need an accountant in 10 years. This suggests a potential decline in the demand for traditional accounting services (Yasseen, Salie and Small 2019). The slow adoption of innovative technologies in the South African accounting industry may be due to a lack of understanding of Industry 4.0's implications and the unique regulatory, economic, and cultural factors in the region.

The recent COVID-19 pandemic has further underscored the need for the accounting profession to embrace digital technologies. The pandemic has highlighted the challenges faced by accountants lacking the digital technology necessary to serve clients in a remote environment. Despite the urgency, there is limited research on the potential benefits of Industry 4.0 on accounting and assurance (Cagle 2020). This gap in research is particularly noticeable in the context of South Africa, and more specifically, KwaZulu-Natal. This lack of scientific evidence hinders the development of effective strategies for the accounting profession to adapt to Industry 4.0.

The accounting sector in KwaZulu-Natal, South Africa, is faced with the challenge of slow adoption and implementation of Industry 4.0 technologies. This reluctance could have significant impacts on businesses and the broader economy if not addressed promptly. Therefore, there is a pressing need for comprehensive research to understand how Industry 4.0 is disrupting the accounting profession and to develop strategies for accountants to adapt to this new technological landscape.

1.5 Aim of the study

The aim of this study is to examine how accounting is influenced by Industry 4.0 in KwaZulu Natal with a view to understand how it is affecting their operations and the opportunities it creates. In addition, the study aims to investigate the role of management in implementing Industry 4.0 and factors influencing accountants in KwaZulu Natal to implement Industry 4.0 as well as to examine cybersecurity risks associated with Industry 4.0 implementation in accounting.

1.6 Research objectives

- To examine how accounting is influenced by Industry 4.0 in KwaZulu Natal.
- To establish the opportunities and challenges presented by Industry 4.0 on the accounting sector in KwaZulu Natal.
- To investigate the role of management in implementing Industry 4.0 in accounting firms in KwaZulu Natal
- To determine the factors influencing accountants in KwaZulu Natal to implement Industry 4.0
- To examine cybersecurity risks associated with Industry 4.0 implementation in accounting

1.7 Research questions

- How is accounting influenced by Industry 4.0 in KwaZulu Natal?
- What are the opportunities and challenges presented by Industry 4.0 for the accounting sector in KwaZulu Natal?

- What is the role of management in implementing Industry 4.0 in accounting firms?
- What are the factors influencing accountants to implement Industry 4.0?
- What are the cybersecurity risks associated with Industry 4.0 implementation in accounting?

1.8 Significance of the study

This study focuses on the influence of Industry 4.0 on accounting which is still an evolving phenomenon globally. The study was conducted in KwaZulu Natal in South Africa, which is considered a developing country. South African accounting firms face electricity disruption, geographical location disadvantage and infrastructural challenges that may not be experienced by developed countries. Therefore, a one-size-fits-all strategy may not work because of the unique issues faced by the South African accounting sector. The study adopts a technology-organisation-environment framework, institution theory and diffusion of innovation theory to explain the influence of Industry 4.0 on the accounting sector. There are limited studies in accounting that combine these three theories to explain how Industry 4.0 is influencing accounting practices at the organisational level particularly in South Africa.

Scholars may also benefit from this study because it provides empirical evidence on how Industry 4.0 is affecting accounting practices. Moreover, there is a dearth of academic research on how the accounting sector is affected by Industry 4.0, and this study fills that gap. However, existing studies indicate that Industry 4.0 is already affecting operations, processes, and business models in the accounting sector.

1.9 Contribution of the study

Professional accountants, accounting firms, lawmakers, and academic institutions may benefit from this research. The study may help accountants better comprehend how innovative technologies are disrupting the work of accountants and how their roles could change in the future in the business environment. In addition, accounting regulatory organisations may use the findings to improve their continuous professional development (CPD)

programmes to provide prospective and current accountants with the essential skills to succeed in this evolving technological environment. Furthermore, academic institutions may consider the findings and, as a result, alter the academic curriculum to align it with the competencies and skills expected of new professional accountants. A qualitative methodological research approach was adopted in the study to examine how accounting is influenced by Industry 4.0.

1.10 Structure of the study

Chapter One covers the following areas, the background of the study, accounting technology, overview of accounting in South Africa, research gap, statement of the problem, aim of the study, objectives, research questions, significance of the study, the contribution of the study, and the conclusion.

Chapter Two dealt with literature review divided into different parts; part a) theoretical framework, accounting in business, evolution of the industrial revolution, Industry 4.0 with respective literature. Part b covered the influence of Industry4.0 in accounting, the challenges and opportunities presented by Industry 4.0 and the role of management in the implementation of Industry 4.0. Part c of the literature review dealt with the factors that influence accountants to adopt Industry 4.0, cybersecurity risks associated with the adoption of Industry 4.0 in accounting and the conclusion.

Chapter Three is organised in following the order of subheadings which indicate the methods that were adopted in this study. The subheadings are arranged as follows; introduction, research design, ontology, epistemology, research paradigm, research strategy, data collection, criteria for recruiting participants, sampling strategy, target population, sample size, trustworthiness of the data, data analysis, thematic analysis, ethical considerations, and conclusion.

Chapter Four covered the presentation and discussion of finding that emerged from theme one. Theme one deals with the influence and opportunities of Industry 4.0 in accounting, demographics of the research participants is also presented and discussed in this chapter and the conclusion of the chapter.

Chapter Five covered the presentation and discussion of finding that emerged from theme two. Theme two dealt with the challenges and risks associated with the implementation of Industry 4.0 in accounting and the conclusion.

Chapter Six dealt with the presentation and discussion of findings that emerged from theme three. Theme three covered the role of management in implementing Industry 4.0 and the responses of accounting firms to cybersecurity risks.

Chapter Seven dealt with the conclusion and recommendation of the study, limitations of the study, future research areas, implications of the study and conclusion of the chapter.

1.11 Conclusion

The chapter presented the study background and research gap. In addition, problem of the statement, objectives, research question, significance and contribution of the study are also discussed in this chapter. The chapter also explained the evolution of Industry 4.0 and the history of technology in accounting. Furthermore, the chapter elaborated on the role of accounting in business and structure accounting in South Africa.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the literature review that gives the background and theoretical foundation for a research study. The chapter is broken down into three parts. Part A outlines the relevant theories adopted in this research study and Industry 4.0 components on how they impact on accounting. Part B and C discuss literature relevant to research objectives. Literature review assists in gaining a better understanding and perspective of previous studies as well as emerging trends.

2.2 Part A: Theoretical framework

2.2.1 Introduction

The previous chapter provided an overview of the research study as well as background information on the topic. This chapter outlines the relevant theories adopted in this research study. A theoretical framework, according to LeCompte and Preissle (1993), is a collection of interconnected principles that can be used to guide research with the aim of explaining and predicting the research findings. Researchers have suggested technology adoption theories and models to monitor the rate at which each innovation spreads (Awa and Ojiabo 2016). Technology adoption is a field that is continually evolving, and there are a number of theories that attempt to understand this phenomenon. In addition, different theories and models have been suggested to better understand how modern technologies spread.

The researcher adopted a combination of Institutional theory and technology organisation and environment framework (TOE) theories to help answer the research questions. There are many theories explaining factors influencing the adoption of technology by individuals and organisations. For example, the Technology Acceptance Model (Davis 1986), Theory of Planned Behaviour (Ajzen 1985), Unified Theory of Acceptance and Use Technology (Venkatesh *et al.* 2003), Diffusion of Innovation (Rogers 1995), Task-technology Fit Theory

(Goodhue and Thompson 1995). However, few explain the element influencing the adoption and implementation of technology at the organisation level.

Institutional theory and the TOE framework theories when combined provide a theoretically sound foundation for examining the factors that influence the adoption of Industry 4.0 in accounting. These theories explain the factors influencing the adoption of technology at an organisation level. The TOE framework indicates that external pressure from business partners, competitors and other stakeholders is a key environmental component in Industry 4.0 adoption. Technology, organisation, and environment are the three constructs of TOE framework, but the variables differ depending on the study setting and industry.

Institutional theory can be applied to analyse the pressures that compel accounting firms to implement Industry 4.0. The theory explains that an organisation's decision to adopt technology can be influenced by the pressure from its trading partners. The environment from which the business operates may play a role in its decision to adopt and implement modern technology. The decision to adopt technology may be influenced by coercive, mimetic, and normative pressure from the organisation's stakeholders.

2.3 Institutional theory

Institutional theory is critical of the notion that an economically rational entity can freely make a best decision without regard for the constraints imposed by the entity's social setting (Katsikas, Rossi and Orelli 2017). The decision by an organisation is influenced by social and cultural variables as well as concerns about legitimacy rather than rational economic objectives (Gibbs and Kraemer 2004; Orlikowski and Barley 2001). Instead of making the decision to adopt Industry 4.0 on their own, accounting firms are more likely to be influenced to embrace Industry 4.0 by their trading partners and other stakeholders. Scott (2005) explains that every organisation exists in a specific physical, technological, cultural and social environment to which it must adapt. Scott (2005) claims that no organisation is self-sufficient; all depend for survival on the types of relations they establish with larger systems of which they are a part. According to Demirbag *et al.* (2017), institutional theory has evolved as an

alternative theory for investigating organisational behaviour in response to external pressures.

The institutional setting in which the organisation is situated may affect the implementation of modern technologies (Katsikas *et al.* 2017). The institutional environment restricts and defines the organisation's internal structure, as well as the behaviour of its actors (DiMaggio and Powell 1983). Institutions are both cognitive and emotional parts of the decisions and choices that people make (Ribeiro and Scapens 2006). Scott (2008) posits that organisations may be regarded as actors in some situations, but they are more commonly thought of as institutions. Gibbs and Kraemer (2004) indicate that trading partners and regulatory authorities such as the government form the environment in which an organisation operates and can generate both incentives and constraints for the implementation and use of certain technology. Cultural beliefs, regulatory frameworks and normative structure are part of the institutional environment that give meaning and stability to a certain sector (Lieberman and Asaba 2006). The institutional environment and its stakeholders have a considerable influence on the development of organisational behaviour, systems, and structures (Gibbs and Kraemer 2004).

Legitimacy seeking behaviour may lead to changes in the regulatory frameworks of an organisation (Baker, Bédard and dit Hauret 2014). Therefore, the use of an accounting information system gives legitimacy to the organisation (Rosli, Paul and Siew 2013). According to Wallman (1997), accounting must change to keep up with technological advancements to meet its purpose of delivering reliable information for efficient and effective decision-making. Mellemvik, Monsen, and Olson (1988) indicate that the sole function of accounting in an organisation is to promote the organisation's legitimisation process. This is because the accounting function is one of the systems and structures that is seen as a representation of an organisation's legitimacy (Sastararuji *et al.* 2021).

Legitimacy is a generalised perception that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions (Suchman 1995). Organisations usually seek to increase their legitimacy in decision-making by exploiting support from their institutional

context (Heikkilä 2013). To secure continued support, deliberate efforts are undertaken to establish, retain, and maintain legitimacy in the eyes of external forces (DiMaggio and Powell 1983; Meyer and Rowan 1977).

Regulation structures and regulatory bodies in highly institutionalised fields face pressures from the state and other external influences that persuade them to adopt behaviours compatible with expectations (Baker *et al.* 2014). This indicates that there must be an adequate level of interaction between a specific type of regulatory structure and its institutional environment for it to fulfil its goals (Heikkilä 2013).

The institutional theory explains that an organisation's performance is measured by how well it embraces social values on rational behaviour (Baker *et al.* 2014). To gain legitimacy and acquire the resources necessary for survival, organisations may choose to adhere to the formal structures and procedures that are recognised in their social and cultural surroundings (McKinley and Mone 2003; Ribeiro and Scapens 2006).

Institutions operate on different levels and are influenced by organisation cultures, structures, and daily routines (McKinley and Mone 2003). DiMaggio and Powell (1983) explain that isomorphic and legitimacy pressures cause firms to grow more similar. This suggests that over time, businesses in the same sector tend to resemble one another as pressures from customers and other stakeholders drive them to imitate industry leaders (Latif *et al.* 2020).

Goddard *et al.* (2016) indicate that isomorphism can help individuals to comprehend the connection between external elements and organisational procedures like influences of Industry 4.0 adoption in accounting. According to Powell and DiMaggio (1983), isomorphism is the tendency for organisations in the same sector to adopt similar forms and practices to gain legitimacy.

DiMaggio and Powell (1983) explain that coercive, normative, and mimetic are the underlying elements that facilitate institutional isomorphism and the adoption of systems and procedures by organisations. Each element has its own set of structures and processes through which it operates (Roxas and Coetzer 2012). Political laws and decrees that impose various forms of limits can be used by the government to apply coercive pressure (Goddard *et al*. 2016). Apart from the

limitations, Katsikas *et al*. (2017) suggest that laws and decrees can offer some type of support, but only if a set of nationally determined rules of the game is followed. Roxas and Coetzer (2012) opine that conformity to institutions is ensured via a coercive mechanism. Berrone *et al.* (2013) agree that external forces and cultural norms in society cause coercive isomorphism. Furthermore, coercive isomorphism, which emanates from political power and the legitimacy dilemma, considers the structure of regulatory or other authoritative implications (Adjei, Adams and Mamattah 2021).

The coercive nature of isomorphism can arise when an organisation adopts norms due to the influence of other organisations and the general public (Berrone *et al.* 2013). Coercive isomorphism may occur as a result of formal and informal pressures applied to organisations, especially those imposed by government mandate (Goddard *et al.* 2016). For example, Enron, Tyco Accounting and Steinhoff scandals in accounting practices have prompted governments to put pressure on accounting firms to implement mandatory audit rotation. Because of the strength of the government and other external influences, a highly institutionalised sector puts pressure on regulatory structures and regulatory bodies to implement practices that are compatible with their expectations (Adjei, Adams and Mamattah 2021).

The normative institutional structure relates to the values, beliefs, standards, and assumptions that exist in the institutional environment and encompass prescriptive, evaluative, and mandatory aspects of social life, as well as providing patterns of acceptable behaviour (Scott 2001; Kostova and Roth 2002). Normative institutions are founded on social interactions and mandatory aspects of these interactions and include rules of thumb, norms, operational procedures, occupational standards, and educational curricula (Hoffman 1999; Wicks 2001). They are made up of values, which represent right behaviour, and norms, which reflect expected behaviour (Scott 1998 2001). Their power to influence worker and firm behaviour stems from the need for conformity, as well as enforcing social responsibility, social necessity, and common understandings of what is acceptable in the workplace (Wicks 2001).

Normative isomorphism “arises when professionals operating in organisations are under pressure to conform to a set of occupational/professional norms and rules” (Abernethy and Chua 1996). In other words, the normative source of isomorphic organisational change originates from professionalisation (DiMaggio and Powell 1991). Organisations feel obligated to embrace structures, procedures, and processes that have been promoted by leading occupational and professional associations in this type of isomorphism (Burns 2000). The normative mechanism is made up of many different professionalisation processes that the government either encourages or does not encourage for use by local institutions through some of the most key actors (Elbardan and Kholeif 2017).

Mimetic isomorphism occurs in an unpredictable environment (Latif *et al*. 2020). According to Scapens (1994), conformity is a key component of mimetic behaviour, in which organisations adopt modern practices in order to appear to be in control of their systems, structures, and processes. Lieberman and Asaba (2006) explain that imitation can be motivated by the desire to acquire information or to limit competition. As a result, governments’ mimetic pressures may stem from a desire to eliminate uncertainty (Kostova and Roth 2002). The government may encourage the imitations of role model actors through mimetic pressure (Kostova and Roth 2002). Mimetic pressures cause an organisation to replicate the behaviours of other structurally similar organisations in the same sector, especially those it deems successful, in order to obtain prestige and legitimacy and avoid being viewed as less technologically advanced (Teo, Wei and Benbasat 2003).

Institutions can be thought of as both cognitive and emotional parts of the decisions and choices that people make (Katsikas *et al.* 2017). Organisations and their members unquestioningly adhere to cognitive structures because of mimetic processes (Zucker 1983; Palmer and Biggart 2002). Many accountants in businesses belong to professional organisations that define the standards for appropriate accounting practices. Institutions have a set of rules about how to get things done (Osinubi 2020). However, mimicking can be caused by a lack of knowledge of technology as well as a lack of direction (Dubey *et al*. 2019). Organisation leadership may give in to mimetic pressures to save on search

costs, reduce experimental costs, or avoid risks incurred by first-movers (Teo *et al*. 2003).

The adoption of digital accounting practice is driven by mimetic behaviour and external pressures (Gullkvist 2011). Jamil *et al.* (2015) suggest that the prevalent ambiguity over new laws, work practices, cost benefits, and effectiveness of technology can be demonstrated through imitation. Gullkvist (2011) further indicates that imitation patterns are also emerging among accounting firms in the creation of services and practices. Sastararuji *et al.* (2021) point out that the increased implementation of digital accounting technology in small and medium businesses in recent years could be attributed to institutional pressures from trading partners and regulatory authorities. Jamil *et al*. (2015) indicate that the increasing requirements for electronic reporting, invoicing, and data transfer by governments, large corporations, and other stakeholders are essential aspects that will certainly have an increasing effect on the adoption of innovative technology in accounting.

2.4 Technology organisational and environmental framework (TOE)

Tornatzky, Fleischer and Chakrabarti (1990) designed the technology, organisation and environment (TOE) framework to take into account technological, environmental, and organisational elements that determine the decision to implement new technologies. In addition, Tornatzky Fleischer and Chakrabarti (1990) believe that the TOE framework provides a solid theoretical foundation for studying technology acceptance at the organisational level. This is because it has clear empirical supports which makes it a good framework to start when evaluating and considering appropriate factors for understanding the innovation-adoption decision (Wang, Wang and Yang 2010). According to the TOE framework, technological, organisational, and environmental are the three factors affecting the adoption and implementation of technology in an organisation (Valdebenito and Quelopana 2019). The TOE framework is a firm-level theory that describes how three different components of a company's context that impacts its technology adoption decisions (Baker 2011).

TOE is exhaustive in analysing information technology (IT) uptake and may be applied in the context of small businesses (Awa, Ukoha and Igwe 2017). Chan

and Chong (2013) explain that there is a likelihood for researchers not to capture the importance of the relationship between organisations when only TOE framework is used in a study. TOE framework frequently overlooks the significance of interorganisational interactions (Chong and Ooi 2008). Lucianetti *et al.* (2018) reveal that the results of the study may be inconclusive if external influences are not taken into account.

Hossain and Quaddus (2011) concur that TOE framework tries to incorporate the socio-economic aspects while acknowledging the interaction between technological advancement and organisational conditions concerning the essential business transformation influenced by industry environment. Moreover, Li, Lai and Wang (2010) suggest that the TOE framework is an integrative framework that incorporates technology attributes, contingent organisational aspects, and macro-environmental elements. The technology, organisation and environment framework offer a valuable analytical schema for analysing the adoption and integration of various technological innovation in an organisation. Some researchers have argued that the TOE framework does not give a differing description for innovation adoption, but rather fits in with existing theories (Puklavec, Oliveira and Popovič 2018). Oliveira and Martins (2011) indicate that for researchers to gain a more comprehensive understanding of the adoption phenomena, it is necessary to mix multiple adoption models and relevant concepts when addressing a specific technology adoption context.

The variables analysed under the TOE framework differ depending on the research study, and they are categorised into three different groups that affect an organisation to adopt new technology. These variables differ depending on the study setting and industry. Siew *et al.* (2020) employed TOE framework to investigate how organisational and environmental influenced audit firms to adopt computer assisted audit tools and techniques in Malaysia. The study revealed that the complexity of customers' accounting information systems, the perceived support from accounting regulatory bodies, firm size, staff IT expertise, and managerial support were determined to be the major factors. Furthermore, study by Ramdani, Chevers and Williams (2013) in North-Western England adopted technology, organisation and environment to investigate small and medium business adoption of enterprise application. Ramdani Chevers and Williams

(2013) found that technology, organisation and environment contexts influenced small and medium businesses to adopt enterprise application. Lautenbach, Johnston and Adeniran-Ogundipe (2017) used TOE to investigate factors that influence organisations in South African to adopt business intelligence and analytics. The study found that the pressure from trading partners, technology capabilities of the organisation and top management support had an influence in the adoption of business intelligence and analytics. Technology, organisation and environment are the three constructs of TOE framework and will be discussed in detail.

2.4.1 The technological context

Zhu and Kraemer (2005) explain that the technological context of the TOE framework encompasses both existing and emerging technologies that are essential to the business. The top management should consider the technology that a company already has during the transformation process because it sets a broad limit on how much and how quickly a company can change its technology. Awa *et al*. (2015) concur that the perceived relative benefit of the technology, perceived compatibility with existing structures and operation, level of complexity of the innovation, the technology's ability to be tested before the implementation, and observability influence an organisation to adopt modern technology.

The introduction of modern technologies results in considerable changes in work patterns, and resistance to change is a common organisational response (Premkumar and Roberts 1999). Oliveira, Thomas and Espadanal (2014) suggest that technological innovations that have a greater relative advantage over existing practices are more likely to be implemented. Rogers (2010) opines that the nature of the technology defines the kind of relative benefit that is relevant to the end user and can translate to economic profit or convey social prestige for the adopter. Low, Chen and Wu (2011) suggest that adopting cloud computing technology could result in cost saving for the business. Any security issues may affect the relative benefit of adopting cloud computing and other technology (Low Chen and Wu 2011). Technology adoption will be encouraged by the perceived benefits of Industry 4.0.

The desire and ability to implement modern technologies is influenced by a firm's level of technological competence. Kumar *et al.* (2016) suggest that technology competence can be assessed by comparing the firm's information technology capabilities to those of its competitors and other industry leaders. The stronger a company's technological competence, the more likely it is that it will accept modern technologies (Zhu, Kraemer and Xu 2002). Technology competence comprises the technological infrastructure and human expertise that can impact a firm's acceptance of new technology (Zhu and Kraemer 2005). The ability to use technology effectively is a driver of information technology adoption (Low, Chen and Wu 2011).

When implementing modern technologies, companies must carefully assess the kind of organisational changes that may result. Certain technologies may have a significant effect on the business and the business sector, and some may cause a minor impact (Woschke, Haase and Kratzer 2017). An organisation can introduce new improvements and updated versions of the existing technologies through incremental innovations (Banbury and Mitchell 1995). For example, security updates on the existing technology used by the organisation. Dewar and Dutton (1986) indicate that incremental innovations involve small upgrades or modifications to existing technologies. Incremental innovations have far fewer risks, and opportunities than radical innovations and they are employed to meet specific market demands over a short time (Ali 1994). Incremental innovations, according to Banbury and Mitchell (1995), are critical to a company's long-term sustainability. However, radical innovations are described as those technologies that result in changes to an organisation's operations and constitute a significant shift from the established organisational procedures (McDermott and O'Connor 2002).

Oke *et al.* (2007) observe that growth-oriented small and medium businesses favour incremental innovations in their improvement initiatives. Hausman (2005) indicates that because small and medium businesses have fewer resources and product mix than their larger competitors, they can reduce risk by implementing incremental innovations. Many existing businesses prefer incremental technological innovations since they are simpler to integrate within the operational boundaries of the business (Mezias and Glynn 1993).

Incremental innovations pose a low level of risk and disruption for the organisational processes and structure.

Modern technology renders the expertise that the industry leaders have learned obsolete, thereby momentarily lowering the entry barriers (Anderson and Tushman 1991). Anderson and Tushman (1991) indicate that industry leaders are hesitant to implement new technology as it erases their initial investments and causes them to fundamentally transform their processes and structure. This is because technologies evolve and change with time. For example, transitioning from traditional computerised accounting to cloud accounting technology. Therefore, organisations must examine whether modern technologies are "competence-enhancing" or "competence-destroying" (Tushman and Anderson 1986). Competence-enhancing technologies allow businesses to evolve over time as they gain experience, but competence-destroying technologies cause existing technologies and knowledge to become obsolete (Baker 2012).

The technological context as described by the TOE framework, influences whether technological readiness of the business will hinder or encourage adoption of modern technology (Chatzoglou and Chatzoudes 2016). Therefore, an organisation should have a certain level of technological readiness for it to be able to implement Industry 4.0. The adoption of modern technology is influenced by a variety of elements depending on the nature of innovation. Organisation structure and processes are two aspects that are likely to change when an organisation adopts new technology (Damanpour 1996).

Technology readiness mitigates the risk associated with perceived technological complexity. The technology readiness construct is influenced by internal elements such as technological infrastructure and digital skills of the employees (Low, Chen and Wu 2011). An organisation is regarded to be ready for new technology when it is able to upgrade, change, or integrate the new technology with the existing company's standards and values (Markus and Tanis 2000). The technology readiness concept illustrates the organisation's level of technological competence. Technology readiness is a concept that is associated with perceived compatibility (Chen, Gillenson and Sherrell 2002). The organisation may regard Industry 4.0 to be compatible if it is aligned with the

company's existing values and beliefs. As a result, compatibility may increase the likelihood of Industry 4.0 adoption and implementation.

2.4.2 The organisational context

Baker (2012) indicated that the organisational context relates to the organisation's characteristics and resources, such as structures that connect employees, intra-organisation communication channels, company size, and the extent of slack resources available. The organisational context is described by the organisation's descriptive characteristics (Baker 2012). Communication procedures can either foster or restrict technological innovation in the organisation. Top management behaviour may encourage innovation by fostering an organisational climate that accepts change and encourages new ideas that advance the company's basic goal and vision (Tushman and Nadler 1986). Therefore, it is important for top leadership to communicate the value of technology to their subordinates, reward technological innovation, and establish a capable executive team that can articulate the company's future (Baker 2012).

Organisational executives handle increasing organisational performance, closing the perceived performance difference, and pursuing new business prospects through the implementation of new technology (Gangwar, Date and Ramaswamy 2015). Top management must allocate the required resources, limit resistance within the organisation and foster a constructive attitude regarding innovation adoption and implementation (Chatzoglou and Chatzoudes 2016; Salum and Abd Rozan 2017). Support from senior management is critical during the adoption and implementation of technological innovation. The attitude of mistrust in new technology at the senior management level can be harmful and might foster scepticism when implementing new technology (Rowles and Brown 2017).

Agote, Aramburu and Lines (2016) explain that it is necessary for top management to gain organisational buy-in to innovation by presenting a compelling strategy and gaining employees' support. The strategy is communicated using a variety of techniques, and it is necessary that the message is effective, that it gets to all members of the organisation. This should be done on a regular basis to ensure that all affected understands the change

vision (Appelbaum *et al.* 2015). The new procedures should be strongly established in the organisation's culture and instilled into new employees.

Hsu *et al.* (2019) explain that it is the responsibility of senior management to provide unambiguous directives and assurances that assist organisations to eliminate ambiguity and appropriately organise technology resources and human resource. Senior management must be dedicated and willing to give business the necessary resources required to implement Industry 4.0 (Hsu *et al*. 2019). Failures in technology adoption might occur because of inadequate technology resources and a lack of support from the senior management (Yang *et al*. 2015). In addition, Yang *et al*. (2015) indicated that support from senior management can have a substantial effect on the implementation of new technology.

Senior executives play a vital role in outlining a long-term strategy of a company (Gummadidala, Karippur and Koilakuntla 2020). Businesses that successfully design a vision that integrates internal business processes with outside digital technology opportunities will gain strategic edge in their respective industries (Yen, Chou and Chang 2002). Many businesses have struggled to cope with the rise of digital technologies and the changes their businesses need to make (Sundaram, Sharma and Shakya 2020). Industry 4.0 is putting pressure on businesses to digitally transform.

The relationship between company size and innovation diffusion is contingent to the size and the level of uncertainty in the industry (Damanpour 1996). Li *et al*. (2018) reveal that adoption of technology is not influenced by the size of the company. Lee and Xia (2006) contend that there is a general relationship between the size of an organisation and the technological innovations it adopts. This relationship is influenced by the type of information technology, size of the organisation and level of adoption (Lee and Xia 2006). Large companies usually have more disposable resources to help with the adoption and implementation of new technology (Li *et al.* 2018). Additionally, larger companies process more transactions as compared to smaller companies (Rogers 1995).

The size of a company is a significant predictor of technology adoption (Rogers 1995). Larger businesses are likely to implement modern technology because they have the financial resources and expertise to do so, as well as economies

of scale to maximise the return on such investments (Dasgupta *et al.* 1999; Iacovou *et al.* 1995). To properly implement modern technology, a company's personnel must have the necessary knowledge and skills (Tornatzky and Fleischer 1990). Evidence from technology adoption research shows that the level of employee technology expertise influence business executive's decision to implement information system (Thong 1999).

Agote *et al.* (2016) reveal that it is critical for top leadership to display consistent behaviour during the adoption of modern technology in order to win employees' and other stakeholders' trust. van Dierendonck and Sousa (2016) suggest that staff and trading partners are more likely to be motivated during the technology adoption and implementation process if top leadership provides appropriate support. The support could be fulfilling and meeting their expectations, providing the resources required, and developing and training them.

2.4.3 Environment context

The environmental context encompasses the existence or absence of technological suppliers, industry characteristics and the regulatory environment (Baker 2012). It includes all aspects influencing the setting from which the business operates. For example, government laws and incentives, consumer demands, competition from other businesses, industry life cycles as well as pressures from other stakeholders. Businesses' trading partners and government regulators may exert pressure on the business to adopt specific business practices (Liang *et al*. 2007).

Kamath and Liker (1994) indicate that the environment in which the business operates plays a key role since businesses can influence one another to adopt an innovative approach to remain competitive. To remain competitive in an uncertain business environment, each industry participant actively and carefully observes and replicates other competitors' actions (Awa, Ojiabo and Orokor 2017). This helps to cushion the pressure emanating from the competitors and other trading partners. Businesses copy successful competitors' creativity and other attributes, particularly those related to technology adoption and implementation (Oliveira and Martins 2011; Gibbs and Kraemer 2004). When businesses are under pressure, they tend to adapt their strategies to fit current

practices that have been established by the industry leaders (Awa, Ojiabo and Orokor 2017). Competitive pressure frequently induces retaliatory behaviour, creating an ongoing vicious cycle (Awa, Baridam and Nwibere 2015; Awa, Ukoha and Emecheta 2015).

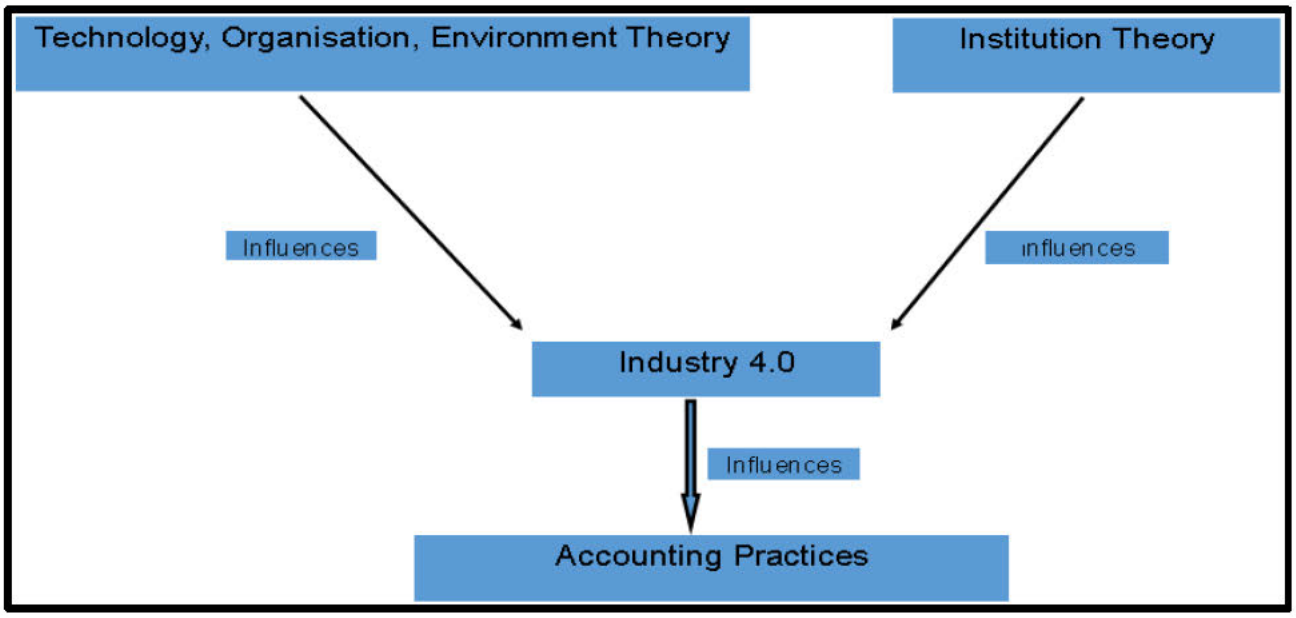
Porter and Millar (1985) assert that technological advances alter competitive rules, reorganise industry structures, and compel companies to embrace innovation to gain an advantage over their competitors. Modern technological platforms change the structure of an industry. They also introduce alternative ways to compete through brick-and-click synergy and electronic integration (Shapiro and Varian 1999).

Environmental conditions and regulations, especially those related to government regulations and incentives might influence the organisations' decision to adopt technology (Oliveira, Thomas and Espadanal 2014). The adoption and success of modern technology is not determined by the organisation alone, but also by the regulatory authorities that develop laws to regulate technology (Marston *et al*. 2011). The regulatory authority may be a local or global body. Technology regulators in some sectors require modern technology to be certified first before it is adopted or implemented. The ability of an organisation to implement an invention would be enhanced if it received regulatory support for a reliable infrastructure (Kandil *et al.* 2018). However, study by Oliveira, Thomas and Espadanal (2014) revealed that regulatory support had no significant influence on businesses to adopt cloud computing.

Zhu and Kraemer (2005) argue that regulatory support is an important environmental variable influencing technology adoption within the TOE framework. Regulatory systems are important for fostering a sense of trust in modern technologies. Inadequate legal protection for online transactions, as well as issues about security and privacy, are concerns often expressed by businesses and customers (Straub *et al.* 2002; Xu, Zhu and Gibbs 2004). Therefore, governments can promote Industry 4.0 adoption by enacting supportive legislation and regulating the Internet to ensure that it remains a trustworthy commercial platform for online transactions.

Figure 2.1 below shows a theoretical framework illustrating how TOE and Institution theories guide the adoption of Industry 4.0 which in turn influences accounting practices.

Figure 2. 1 Theoretical framework



Source: Own Compilation

2.5 Conclusion of the theoretical framework

Technology, Organisation, Environment theory posits that technological, organisational, and environmental factors influence an organisation's adoption of modern technology in an organisation (Tornatzky and Fleischer 1990). In the context of the accounting profession, technological factors might include the existing IT infrastructure and the availability of technological resources. Organisational factors could include the size of the accounting firm, its readiness for change, and the skills and knowledge of its staff. Environmental factors might include industry characteristics, market competition, and regulatory requirements. Understanding these factors can help accounting firms navigate the transition to Industry 4.0.

Institution theory suggests that organisational decisions are influenced by institutional pressures, which can be regulatory (laws and regulations), normative (industry norms and best practices), or cognitive (shared beliefs and common

understandings) (DiMaggio and Powell 1983). Regulatory pressures might come from accounting standards and regulations in the accounting profession. Normative pressures could come from professional accounting bodies and industry best practices. Cognitive pressures might include shared beliefs about the value of Industry 4.0 or common understandings of what constitutes good accounting practice. These pressures can influence how accounting firms approach the adoption of Industry 4.0.

The adoption of Industry 4.0 influences accounting practices. With the adoption of Industry 4.0, accounting practices may need to evolve to keep up with changes in business processes, data availability, and reporting requirements. The theoretical framework of this study aligns with the accounting profession by providing a lens to understand the factors that influence the adoption of Industry 4.0. Understanding these factors can guide accounting firms in navigating the transition to Industry 4.0.

2.5.1 Accounting in business

Accounting has a documented history dating all the way back to at least 2000 BC, when the ancient Roman, Egyptian, Indian, and Greek civilisations started trading (Anandarajan, Srinivasan and Anandarajan 2004). Accounting is regularly referred to as the language of business due to its role in communicating financial data. Accounting may be characterised as a language used to communicate between departments and between businesses (Turker and Bicer 2020). Since ancient times, the language of accounting has evolved.

Accounting offers users relevant financial data to assist them in making important decisions such as business planning. In addition, accounting data gives owners or managers the information they need to determine if the business goals set during the planning phase are being accomplished (Birt *et al*. 2020). Therefore, when these goals are not met, management can respond appropriately to alter the entity's operations to maintain alignment with the initial business strategy. Perry (2001) claims that simply having a business plan in place does not guarantee firms' survival. Business plans cannot eradicate uncertainty, as no organisation can operate in an entirely predictable environment (Birt *et al.* 2020).

Forensic accounting and auditing are interconnected. Mojsoska and Dujovski (2015) reveal that in the event of fraud or abuse, a forensic accountant estimates the financial losses sustained by the institution. Internal control can protect the authenticity of financial records and their compilation by implementing specific policies and procedures (Bassey 2018). Internal auditors assist in fraud prevention by examining and evaluating internal controls that lower the risk of fraud (Abiodun 2020). They also assist in detecting fraud by employing audit techniques that uncover false financial reporting and asset misappropriation (Arens *et al.* 2017). Individuals can manipulate financial statements for a variety of reasons.

Auditing is one area of accounting that plays an integral part in the monitoring process and ensures that anti-fraud measures as well as controls are working properly (Heydt 2020). Internal auditing helps detect and prevent fraud (Ertan 2021). Internal audit is a critical supportive, and complementary aspect of forensic audit (Heydt 2020). It is unavoidable that accounting-related fraud may occur, considering that financial statements are a compilation of financial records (Belak and Hauptman 2011). Audits play pivotal roles in determining if an internal control gives adequate assurance to relevant stakeholders (Abiodun 2020).

Arens *et al.* (2012) describe accounting as the systematic recording, classification, and summarising of economic events to provide financial data for decision-making. Accounting is primarily thought of as a tool for making economic decisions (Horvat and Korošec 2015). Organisations use the accounting information system to build accountability structures and procedures, as well as to evaluate their financial performance (Turner, Weickgenannt and Copeland 2020). Accounting compiles and presents financial data about the business operations and activities for different users. Lebas (1995) points out that conventional accounting system is categorised into several sections depending on its functions. For example, financial accounting, auditing, taxation, cost, and management accounting and environmental or sustainability accounting.

Financial accounting is the preparation of financial statements, such as the statement of financial position, statement of comprehensive income, cash flow

statement and accompanying notes, to assist internal and external users in making an economic decision (Lebas 1995). Financial reporting is governed by domestic legislation and international standards that outline how various financial elements should be regarded (Hamilton 2011). The way financial statements are drafted is regulated by GAAP, which establish accounting standards (Atağan and Kavak 2017). Financial accounting has always been reliant on historical information derived from previous business transactions (Aksoy and Uzay 2021).

The scope of accounting has expanded to include tackling climate change issues and reporting for carbon emissions (Linnenluecke, Birt and Griffiths 2015). Businesses are now expected to generate reports that incorporate both financial and non-financial information as part of their corporate sustainability. Non-financial information seeks to broaden the extent of accounting reporting by incorporating sustainability issues into the conventional accounting framework. Ertan (2021) indicates that apart from financial data, decision-makers also require non-financial data to make decisions. Non-financial data is communicated to decision-makers through the publication of sustainability reports (Ertan 2021). It has become critical for businesses to incorporate sustainability into their financial reports and decision-making process.

Cost and managerial accounting helps managers make informed decisions aimed at generating economic value across the firm (Berisha and Asllanaj 2017). Cost accounting is concerned with determining and recording the overall cost of production through the use of specific procedures and communicating this information to management for consideration (Weygandt, Kimmel and Kieso 2009). Managerial accounting, often known as management accounting, is concerned with creating reports for internal users, focusing on the goals of management (Mihăilă 2014). The structure of managerial accounting is less rigid than that of financial reporting (Weygandt, Kimmel and Kieso 2009). Strategic planning, cost and production analysis, and budgeting are the activities that fall within the scope of managerial accounting (Mihăilă 2014). The role of management accountants is evolving into that of an internal consultant in which they provide financial and operational advice to other managers (Lambert and Pezet 2011; Chotiyanon and de Lautour 2018).

Tax accounting is concerned with a company's taxes. Schneider and Samkin (2008) explain that the accounting records and reports used in tax accounting are based on GAAP, and they should also comply with International Financial Reporting Standards (IFRS). Schneider and Samkin (2008) opined that tax accountants may be in charge of auditing business tax returns and making sure that tax regulations are followed. Tax accountants have a thorough knowledge of tax legislation and can advise businesses with both filing tax planning and tax returns (Venter, Gordon and Street, 2018). When preparing a financial statement in line with tax regulations, it is imperative that the financial statements are easily verifiable (Agarwala *et al.* 2014). While the procedures for calculating accounting profit and tax liability differ, the revenue authorities base their tax assessments on accounting records derived from financial statements (Agarwala *et al.* 2014). Tax accountants serve as intermediates between the tax authorities and businesses by offering taxation advice to firms to maintain compliance with tax legislation (Belak and Hauptman 2011).

2.6 Evolution of the industrial revolution

The business community have undergone three distinct cycles of the industrial revolution. The first industrial revolution began in the year 1760 with the steam engine invention (Xu, David and Kim 2018). This facilitated the change from farming and old-fashioned society to the new process of manufacturing (Bloem *et al.* 2014). Although trains were the primary means of transport, the change involved the use of coal as the primary source of energy (Maynard 2015).

It was the ability to use water and steam energy to create more effective and efficient industrial processes that triggered the First Industrial Revolution (Penprase 2018). Steam engines were used in mining and steam power played a significant role in the expansion of manufacturing. Hobsbawn (1999) indicate that "the industrial revolution is not merely an acceleration of economic growth, but an acceleration of growth because of, and through, economic and social transformation". In terms of employment, the value of output, and capital investment, textiles and steel were the dominant industries (Bloem *et al.* 2014).

The invention of the internal combustion engine in 1860-1900 marked the beginning of the second industrial revolution (Gleason 2018). This culminated in

a period of rapid industrialisation to fuel mass production using oil and electricity (Prisecaru 2016). Atkeson and Kehoe (2007) named the second industrial revolution as a new economy. This period was defined by the emergence of a sophisticated industrial economy, advances in steam power, a new mode of transport, and innovative communication technologies (Smil 2005). The growth of technological systems was a direct outcome of evolving industrial technologies. Li, Hou and Wu (2017) reveal that during this period, a number of industries realised enormous economies of scale.

The second industrial revolution profoundly affected social structures, like people's living conditions, scientific concepts, infrastructure, art, and culture (Mohajan 2019). There were more activities and goods that could be made during the second industrial revolution than there were in the first revolution (Mokyr and Strotz 1998). As a result, the standard of living and purchasing power of money improved rapidly as new technology penetrated the lives of the working class (Mokyr and Strotz 1998). The innovative technologies that had a significant impact on the living conditions of people in the twentieth century were developed in the second industrial revolution (Mohajan 2019). For example, electricity, petroleum products, telecommunication devices and internal combustion engines.

In 1960, the third industrial revolution began and was marked by the introduction of electronics and information technology to automate production (Hirschi 2018). This era was characterised by the widespread use of electronic and computer technologies, as well as the automation of manufacturing processes (Li, Hou and Wu 2017). The current industrial revolution is built on the speedy sharing of information enabled by the third industrial revolution’s digital technologies (Thomas and Nicholas 2018). The availability of information made it easier to share and collaborate on designs and development (Thomas and Nicholas 2018).

Troxler (2013) alludes that the third industrial revolution is underway now. This could be the case because automation and intelligence manufacturing are the cornerstones of the fourth industrial revolution in which a production process can communicate with itself. During the third industrial revolution, the global markets

turnover rose threefold due to increased production and transportation (Mowery 2009). Profitability was shifted away from production phases toward design and development (Pozdnyakova *et al.* 2019). Furthermore, Kupriyanovsky *et al.* (2016) show that labour efficiency increased throughout the third industrial revolution, which led to lower employment of blue-collar workers. The third industrial revolution marked the collapse of centralised corporate structures in favour of decentralised systems and horizontal interaction (Pozdnyakova *et al.* 2019).

In its architecture and implementation, Industry 4.0 emphasises six main principles: virtualisation, real-time capability, interoperability, service orientation, decentralisation and modularity (Hermann, Bücker and Otto 2020). Virtualisation enables the communication between machine to machine and process monitoring (Koh, Orzes and Jia 2019). Virtual environments created from real-time sensor information can be utilised to monitor and manage physical processes because they are constantly synchronised and updated. Sensor data is connected to simulation models and virtual plant models to create a virtual copy of physical objects (Mrugalska and Wyrwicka 2017). Sensors are “small autonomous devices with multi-layered architecture as per the IoT reference model for collecting data and storing in the solid-state memory within their microchips” (Tiwari and Khan 2020). It means that machines can monitor physical operations (Koh, Orzes and Jia 2019). When the possible risks or failures in the virtual models are established, operators are notified and may take pre-emptive action (Kamble *et al.* 2018), thus minimising the actual rate of error and smoothing the inter-organisation activities (Brettel *et al.* 2014).

The real-time capability of Industry 4.0 denotes the immediacy and real-time delivery of data collection and analysis (Skilton and Hovsepian 2018). The smart factories brought by Industry 4.0 need continuous monitoring and analysis of real-time data, timely identification of errors and fulfilment of new demands (Wang and Wang 2016). These factories would have the flexibility to adjust to evolving business conditions, technology changes and regulations in real-time in future (Schlick *et al.* 2014). If a mechanical failure is noticed, the company will respond to the fault immediately and redirect processing to other machines (Shrouf, Ordieres and Miragliotta 2014). Kim and Vasarhelyi (2012) developed a

model to continually detect fraudulent financial transactions in the wire transfer payment process. The model can detect suspected fraud quickly and alert auditors for further inspection by assessing each transaction with pre-set fraud indicators and assessing overall fraud risk.

Interoperability is an enabler of Industry 4.0 and a crucial design feature for a potential lifestyle, such as interoperability between payment systems and financial institutions, allowing customers to make transactions with each other. Additionally, interoperation between traffic lights and vehicles in which traffic lights can connect to a network in the future and provide details on their time schedules and colours (Drath and Horch 2014). In Industry 4.0, all field equipment, machinery, plants, warehouses, and goods will be linked and shared via a global network that allows businesses and entire value chains to interoperate (Drath and Horch 2014). Interoperability can automate transaction monitoring and highlight suspicious transactions for management and auditors (Dai and Vasarhelyi 2016). Transactions from various business operations could be collectively used within an organisation to check the continuity of the operations (Kogan *et al.* 2014).

The service orientation feature of Industry 4.0 affords devices to satisfy the needs of users through the internet of service (Hermann *et al.* 2020). As all entities in the production line are interconnected, the idea of the product would also extend from the product itself to the product service (Lasi *et al.* 2014). The service-oriented feature of Industry 4.0 was defined by Hermann *et al.* (2020) as the services of businesses, CPS, and humans are available over the internet of systems (IoS) and can be used by other participants. Any resource can be offered across a network, such as manufacturing lines, assembly lines, storage, computing, labour, professional knowledge, and businesses can pay for each service (Li *et al.* 2015).

Decentralisation in the Industry 4.0 ecosystem implies that businesses, employees, and even devices can make independent decisions rather than relying on centralised decision-making by using embedded computers that provide individual control and independent decision-making capabilities for employees or devices (Marques *et al.* 2017). The growing demand for

personalised goods and services complicates today's production systems, and it is, therefore, difficult to manage machines centrally (Hermann *et al.* 2020). Individualised products have a higher importance in Industry 4.0, implying more personalised goods and smaller numbers of the same item (Schuh *et al*. 2014).

In Industry 4.0, modular systems are popular because they can easily adapt to evolving conditions or requirements (Mrugalska and Wyrwicka 2017). In the modular production system, devices can be assembled, substituted, and expanded as needed (Qin *et al*. 2016). Vasarhelyi *et al.* (2014) proposed that an auditor can use audit apps to perform a full analytical procedure by assembling audit apps as modules. Each audit app often performs a single analytics-based audit test, and auditors can select and deploy suitable audit apps based on the individual risk assessment (Dai and Vasarhelyi 2016).

2.7 Industry 4.0 components with respective literature

2.7.1 Introduction

It is noteworthy to explore and discuss the key components of Industry 4.0. Akter *et al*. (2020) put forward that it is critical to evaluate the Industry 4.0 components and their corresponding features to establish the fundamental tenets of a specific future business environment. As such this section provides information on the basic components of Industry 4.0 together with the respective literature. Among the components are cyber-physical systems (CPS), Cloud systems, Machine to machine (M2M) communication, Smart factories, Internet of Things (IoT), Data mining and Artificial intelligence (AI). These components are discussed below giving reference to the accounting profession as they bear much relevance.

2.7.2 Cyber-physical systems (CPS)

Cyber-physical systems are a class of systems that integrate computing and communication capabilities with physical processes (Chiang, Guo and Zhang 2020). These systems enable the seamless integration of the digital and physical worlds, enabling the creation of modern technologies and capabilities that were previously unimaginable (Ghobakhloo 2018). Cyber-physical systems have the potential to revolutionise a wide range of sectors, including transportation, manufacturing, healthcare, and accounting, by enabling the development of

intelligent, autonomous, and responsive systems that can adapt to changing environments and user needs (Liao *et al*. 2017).

One key characteristic of CPS is their ability to sense and actuate the physical world. This is achieved through the use of sensors, actuators, and control algorithms that enable the system to gather information about the environment and make appropriate decisions based on that information (Chiang, Guo and Zhang 2020). For example, a CPS in the transportation sector might use sensors to detect obstacles in the road and adjust the vehicle's speed or trajectory accordingly, while a CPS in the manufacturing sector might use sensors to monitor the quality of a production process and adjust it in real-time to ensure that the final product meets the required specifications (Liao *et al*. 2017).

Another characteristic of CPS is its reliance on communication and networking technologies to enable the exchange of information between different components of the system (Ghobakhloo 2018). This enables CPS to be distributed and decentralised, with different components of the system able to operate independently and communicate with one another as needed (Madsen and Mikkelsen 2018). The decentralised structure makes CPS well-suited for applications that require robustness and flexibility, as it allows the system to continue operating even if one or more components fail (Munyai, Mbonyane and Mbohwa 2017).

Cyber-physical systems have the potential to bring about significant changes in a wide range of sectors, but they also pose a number of challenges that need to be addressed in order to realise their full potential (Madsen and Mikkelsen 2018). There is a challenge in ensuring that CPS are safe and reliable, as these systems often directly impact the physical world and can have serious consequences if they fail (Yin, Stecke and Li 2018). As CPS rely on communication and networking technologies, they are vulnerable to cyber-attacks that could compromise the system's operation or even cause physical harm (Munyai, Mbonyane and Mbohwa 2017). Yin, Stecke and Li (2018) state that CPS must be designed with security consideration and that appropriate measures are in place to prevent, detect, and mitigate cyber-attacks.

2.7.2.1 How CPS affect accounting

The influence of CPS in the accounting sector in South Africa has been significant and is expected to continue growing in the future. In the accounting business, CPS plays a role in integrating sensing, computation, control, and networking into real-world infrastructure and physical things, linking them to the Internet and one another (Higgs *et al.* 2017). The considerable influence of CPS in the accounting industry is the ability to automate and streamline accounting processes, which has helped to reduce costs and increase efficiency for firms in South Africa. With the advancements in CPS technology, the concept of bookkeeping will no longer be central to the accounting industry (Badem and Kilinç 2019). Cyber-physical systems have had an influence on the way that accounting firms in South Africa operate. With the ability to automate many tasks, firms have been able to reduce their reliance on manual labour and focus on higher-value services such as strategic planning and consulting (Cooper *et al*. 2022). The efficiency is improved by CPS systems where the supply chain collaborates (Badem and Kilinç 2019). This allows firms to become more competitive and efficient, leading to improved profitability.

Cyber-physical system in the accounting profession provides a strong support for information security from senior management and improves the engagement between audit and the cybersecurity function (Steinbart *et al*. 2018). The cyber-physical system can help improve the security of financial information by providing a more robust and responsive security infrastructure that can detect and respond to security threats in real-time. Kesan and Hayes (2017) put that understanding institutional cybersecurity now necessitates taking a holistic approach that takes into account legal, financial, and regulatory considerations. The CPS can be used to secure financial transactions by integrating various security measures, such as encryption, authentication, and access control, into the system (Humayed *et al*. 2017). This can help protect against unauthorised access to financial information, prevent fraud and cyber-attacks.

Choi, Kim and Jiang (2017) conclude that it is practical impossible to completely prevent all cybersecurity risks, irrespective of the number of evident controls. But CPS can be used to continuously monitor the system for any suspicious activity

or anomalies, and alert security personnel in case of a potential breach (Humayed *et al*. 2017). This can help detect and respond to security threats in a timely manner. Cooper *et al*. (2022) elaborate that because a breach reveals an organisation's control and system weaknesses, a thorough forensic investigation is frequently required to determine the source of the intrusion and reduce the likelihood of a future incident.

Cooper *et al*. (2022) assert that CPS can be programmed to automatically implement security measures, such as blocking access to certain areas or shutting down the system in case of a security breach. This helps to prevent or minimise the impact of a security threat. Cyber-attacks against a business have been linked with the theft of intangible assets and business secrets (Alashi and Badi 2020). The deployment of CPS can enhance physical security by integrating security measures such as surveillance cameras, alarms, and access control systems into the system thereby preventing unauthorized access to financial information.

Aslanertik and Yardımcı (2019) posit that CPS enable financial information to flow automatically and in real-time, which results in automatic financial data storage and instant recording. Cyber-physical system can help with the storage of accounting information through the use of sensors and other devices that can collect data about financial transactions and other relevant activities (Humayed *et al*. 2017). This data could then be transmitted to a central server or other storage location, where it could be processed and analysed to provide insights into the financial performance of the organisation.

Badem and Kilinç (2019) opine that CPS combines the virtual and physical worlds by connecting the devices and storage systems utilised in production by establishing networks in businesses. For example, CPS can be used to track and record the flow of goods and services within a supply chain, providing detailed information about the costs and revenues associated with each step of the process (Manavalan and Jayakrishna 2019). This could be useful for accounting purposes, as it would provide a complete and accurate picture of the financial performance of the organisation. By leveraging the power of CPS, it may be possible to develop systems that can identify patterns and trends in financial data

and provide insights and recommendations to decision-makers in real-time. Dai (2017) posits that CPS could be used in audits to track and analyse accounting data flow, identify behaviour patterns of various business sectors, find errors, and take immediate corrective action.

Cyber-physical systems can support decision-making in the accounting industry through the use of data analytics and artificial intelligence (AI) tools. These tools can process and analyse large amounts of data, providing insights and predictions that can inform decision-making. Waschull *et al*. (2020) explain that CPS provides better data integration and decision-making capabilities in business processes. By automating tasks such as invoicing, bookkeeping, and tax preparation, CPS can free up time and resources that can be used for more high-level decision-making. Modern analytic systems are a key component of Industry 4.0 that allow for evaluations and decisions to be made in real-time (Skilton and Hovsepian 2018).

2.7.3 Cloud Systems

The term "cloud" refers to applications like remote services, performance benchmarking and colour management. As such, cloud computing is a method of storing all applications, programs, and data on a virtual server (Sadeeq *et al*. 2021). By ensuring that both customers and employees have access to the same data simultaneously, it streamlines operations (Manavalan and Jayakrishna 2019). Costs are decreased, infrastructure complexity is eliminated, the work area is expanded, data is protected, and information is accessible at any time with cloud systems (Hurwitz and Kirsch 2020). It has captured the attention of the information technology community, and its role in other business areas will continuously grow. Along with notable improvements in data management, machines, and functionality will continue to shift from traditional approaches to cloud-based solutions as technology advances (Sadeeq *et al*. 2021).

Cloud system enables faster updates, standalone system delivery, up-to-date performance models, and other delivery options (Hurwitz and Kirsch 2020). The use of cloud solutions has changed the business landscape, and this trend will continue to expand and present a challenge to other methods of data storage (Hurwitz and Kirsch 2020). The simplest online storage option is the cloud, which

offers operational convenience with web-based applications that do not need any installation (Nunez *et al*. 2017).

Li *et al*. (2017) put forward that cloud systems are an excellent source of big data solutions. Since traditional computers may be incapable of handling large amounts of data, using a cloud system would be much easier and more efficient. As a result, data analysis and cloud systems should be unavoidable components of Industry 4.0. There has been a significant amount of integration of cloud-connected robots into daily life. For instance, small businesses with high productivity levels will use cloud-connected robots in manufacturing facilities (Li *et al*. 2017). The transition to the fourth industrial revolution will increase production speed and quality, benefiting both large and small businesses. The use of cloud systems in Industry 4.0 environments has been studied, considering the aforementioned justifications Li *et al*. (2017).

Chang *et al*. (2016) investigated the big data infrastructure of cloud systems and ensured efficient data manipulation to maintain better access. The methodology proposed can be used to create data interpretation and analysis systems for Industry 4.0 implementations. While Higashinoa *et al*. (2017) investigated Complex Event Processing (CEP), Stream Processing (SP), and big data velocity dimension and presented a simulator for these systems in cloud technology, Badawi *et al*. (2017) developed a model for utilising collected data for improving the participants' level of physical activity. They concur that all elements of Industry 4.0 should be compatible with those described and that cloud systems require big data management methodologies.

Li *et al*. (2017) demonstrated a future pre-processing step to monitor land-cover change. Their model can detect cloud shadows in multi-feature combined imagery and operate on the cloud. Some cloud system research focused on cloud structures and design issues, as well as utilisation efficiency and effectiveness. A new cloud management framework known as the Software Defined Cloud (SDCloud) system was introduced by Jararweha *et al*. (2017). It integrates various software-related cloud components to manage implementation complexity. To allow and monitor software access in cloud environments, Carniani *et al*. (2016) presented an advanced authorization

service based on a Usage Control model. Chen and Chiu (2017) presented a simulation model for simulating a mobile factory in their cloud project.

Similarly, Yang *et al*. (2017) created a web page that allows users to easily access and control cloud virtualisation and compared a variety of existing container-based cloud technologies. Michona *et al*. (2017), on the other hand, studied the simulation process and its accurate predictions, making this feature a useful tool for users. Piccialli *et al*. (2017) compared several design alternatives for mapping social media information. The system gathered and evaluated the tweets sent out across the entire region in real-time. Yaseen *et al*. (2017) presented a methodology for running cloud systems with high performance while minimising the CPU (computer performance). Junghanns *et al*. (2016) investigated a novel secure cloud gateway-based architecture that enables client systems to store sensitive data. and investigated the performance and quality of the corresponding code.

Yang *et al*. (2017) compared a variety of existing container-based technologies for the Cloud and created a web page to enable users to easily access and control cloud virtualisation. Michona *et al*. (2017) research on the simulation process and its precise predictions made this feature a useful tool for users. Piccialli *et al*. (2017) compared a range of design options for social media information mapping. The system gathered and evaluated the tweets sent out across the entire region in real-time. Yaseen *et al*. (2017) presented a methodology for running cloud systems with high performance while minimising the CPU (computer performance).

Junghanns *et al*. (2016) investigated a novel secure cloud gateway-based architecture that enables client systems to store sensitive data and investigated the performance and quality of the corresponding code. Ojha *et al*. (2017) created a model for energy optimisation and presented the appropriate framework and duty scheduling mechanisms to save energy. Deng *et al*. (2015) used a value model to reflect the value between various cloud system participants. To create products that are environmentally friendly, Huang *et al*. (2017) proposed a methodology relationship of modular architecture for disassembling components over the cloud. Oesterreich and Teuteberg (2016)

proposed an intriguing method for a Mobile Cloud Network infrastructure's cost- and capacity heterogeneity. The mobile cloud was highlighted by Nawrocki and Reszelewski (2017), who suggested a mobile cloud computing environment as a good way to control resource demands. They suggested that using common cloud computing patterns in a mobile cloud computing environment would be sufficient to limit Industry 4.0's resource demands.

The performance of cloud systems has been and continues to be a major focus of research over the past ten years. This problem is also linked to ensuring that Industry 4.0 compliant systems are functioning. When Ding *et al*. (2017a) suggested an Industry 4.0 cloud system, they succeeded in raising the effectiveness of the corresponding goals. They demonstrated the necessity of the cloud system for system performance as well as inter-machine communication, productivity, and data estimation. Remarkable results in both lowering energy consumption and maintaining system performance were demonstrated by Bui *et al*. (2013). This study showed that a consumer can automatically provision computing capabilities without interacting directly with each service provider.

2.7.3.1 How it impacts on accounting

Cloud systems have had a significant impact on accounting practices in recent years. Ma, Fisher and Nesbit (2021) state that with cloud-based systems, accountants no longer need to spend time on tasks such as data entry, data storage, and software updates. Instead, they can focus on more high-level tasks, such as analysis and strategy development (Gummesson 2018). Accountants can access financial data from anywhere, anytime, as long as they have an internet connection (KPMG 2018). The availability of financial data at any time and from different locations is helpful for accountants working for businesses with multiple locations.

Cloud systems allow businesses to have better and more up-to-date financial performance information, which can aid in decision-making and strategic planning (Razzaq and Mohammed 2020). Cloud systems have also had an impact on the way that businesses present their financial statements (Deloitte 2018). With traditional systems, financial reporting can be time-consuming, as it

involves collecting and organising data from various sources (Rosati *et al*. 2019). Cloud systems, on the other hand, allow businesses to streamline this process by providing real-time data and automated reporting capabilities (Razzaq and Mohammed 2020). The adoption of cloud systems in accounting could lead to the emergence of new job roles in the industry and the potential for some existing roles to become obsolete.

Cloud systems play a role in the broader adoption of modern technology in the accounting sector. The use of cloud systems has facilitated the adoption of other technologies, such as artificial intelligence (AI) and machine learning, in accounting (Gummesson 2018). For example, some cloud-based accounting systems offer automatic invoice processing and expense categorisation features, which rely on AI and machine learning algorithms (Sobhan 2019). These features can save practitioners time and improve accuracy, as they can handle tasks that would otherwise be done manually. Using AI and machine learning in accounting can also lead to improved decision-making, as it allows practitioners to analyse large amounts of data more quickly and accurately than traditional methods (Sobhan 2019). Cloud systems have also made it easier for businesses to comply with regulatory requirements (Sobhan 2019). Many cloud-based accounting systems offer built-in compliance features, such as automatic tax calculations and audit trails (Deloitte 2018).

The adoption of cloud systems can potentially change the way that practitioners work, and the skills required for success in the industry (Achar 2018). While these systems are generally easy to use, some practitioners may need additional training to fully utilise their features (KPMG 2018). For example, the increased automation and efficiency provided by cloud systems may mean that practitioners need to shift their focus from tasks such as data entry and reconciliation to higher-level activities such as analysis and strategy development (Achar 2018). With traditional systems, practitioners may have needed to spend more time on-site with clients to access financial data and perform tasks (Rao, Jyotsna and Sivani 2017). However, with cloud-based systems, practitioners can access data and perform tasks remotely, providing more flexibility and convenience for both practitioners and clients (Rao, Jyotsna and Sivani 2017). Big data management relies heavily on cloud technology's

strong, scalable on-demand storage and processing capabilities (Yang *et al*. 2020). This may require practitioners to develop new skills or update their existing skillset to remain competitive (Whysall, Owtram and Brittain 2019).

Cloud systems also offer increased security. Data stored in the cloud is backed up regularly and protected by multiple security layers (Deloitte 2018). While cloud systems generally offer increased security compared to traditional systems, there is still a risk of data breaches or other security incidents (Rosati *et al*. 2019). Some firms and practitioners have raised concerns about the potential loss of control over financial data when using cloud systems (Ma Fisher and Nesbit 2021). With traditional systems, businesses store and manage their own financial data (KPMG 2018). However, with cloud-based systems, data is stored and managed by a third-party vendor (Deloitte 2018). This may raise concerns about data privacy and control, as businesses rely on vendors to secure and protect their financial data. Coyne, Coyne and Walker (2017) put that one of the major drawbacks of cloud computing is downtime, which is frequently mentioned. Service interruptions are always a risk because cloud computing systems are internet-based and can happen for any reason.

2.7.4 Machine to machine (M2M) communication

Machine-to-machine communication is defined as direct communication between devices via any channel, wired or wireless. Machine-to-machine communication can include industrial instrumentation, which allows a meter to send data to application software that can use it (Biral *et al*. 2015; Amodu and Othman 2018). Such communication can be conducted by having a network of distant machines send data to a central hub for analysis before being forwarded to a device like a personal computer. Machine-to-machine is the technology that enables businesses to set up wireless communication, particularly, between data centers and machines. For example, M2M communication in Blockchain smart contracts allow automated payment without human involvement with reliability and traceability of the transactions (Ferreira *et al*. 2020).

Making communication technologies, whether cable or wireless, as simple, and inexpensive to implement as possible has paved the way for life-improvement innovations (Ackermann 2013; Chen *et al*. 2017). In Industry 4.0 environments,

M2M technology has the potential to reshape various aspects of decision-making, particularly quality control, operational efficiency, customer relationships, and transactional opportunities (Chen *et al*. 2017). Access to real-time, actionable data is required to build smarter, more agile organisations. This enables management to better manage resources, safeguard enterprise-specific assets, deploy intelligent e-business applications to broaden the scope, and respond quickly to rapidly changing environmental requirements. The best services can be provided and tailored to customers with the right intelligence, delivered in real-time, and used appropriately (Guzman and Lewis 2020).

Bello, Zeadally and Badra (2017) note that M2M communication in a smart network makes it simple to monitor resources and improve usage. Smart systems can help cut down on operational costs. Competitiveness can be successfully maintained when M2M is able to use data to automatically trigger and carry out decisions that serve business objectives. Kumar and Vaishya (2018) note that in the manufacturing industry, M2M communication can be used to improve efficiency and reduce waste by automating processes and monitoring equipment. Machine-to-machine communication can be implemented to automate rules-based transactions in accounting. For example, the reconciliation of bank statements, matching invoices with quotations and purchase orders can be automated.

2.7.4.1 How M2M impacts accounting

Machine-to-machine communication allows a sensor to transmit the data it records to application software that can utilise it in the accounting industry. A remote network of machines can communicate by sending data to a central hub for examination, where it is then forwarded onto a device like a personal computer. In the researcher's view, this promotes efficiency in business. Using South Africa as an example, Afanasev *et al*. (2018) assert that at the beginning of 2020, more than half (54 percent) of South African accountants would have abandoned conventional service models in favour of reinventing their core technologies, hiring strategies, and skill sets to provide clients with an all-inclusive consulting service utilising machine to machine technology.

According to Tuna *et al*. (2017), M2M communication increases the amount of data that is easily available by identifying and eliminating repeated procedures and recordings from the everyday job. Machine-to-machine communication has helped to streamline accounting processes, making them more efficient and faster. Software programs can analyse and interpret large amounts of data quickly, allowing accountants to make informed decisions faster. Hussain, Anpalagan and Vannithamby (2017) assert that the fundamental idea behind M2M network is to make it possible for remote devices and central management software to exchange data in real-time, in order to increase the efficiency of the remote machines for the users. Machine-to-machine communication has enabled the automation of many accounting tasks, such as data entry, account reconciliation, and financial reporting. It allows accountants to focus on more complex and value-added tasks, rather than spending time on repetitive and tedious tasks (Albashrawi 2021). Additionally, Machine-to-machine communication can help improve the accuracy of accounting tasks by eliminating human error (Albashrawi 2021). For example, software programs can automatically check for errors and inconsistencies in financial data thereby reducing the risk of mistakes.

According to Tuna *et al*. (2017), M2M is essential in accounting because it can spot irregularities like duplicate invoices, identify connections between what appear to be routine payments but are not, and classify spending into the appropriate categories. Machine communication can provide accountants with access to real-time financial data and analysis tools, which can help them make more informed decisions (Albashrawi 2021). Accountants can use software programs to analyse financial data and identify trends, allowing them to make more strategic decisions (Li and Vasarhelyi 2018). Machine-to-machine communication can be used to monitor the status of production lines, allowing for timely maintenance and reducing downtime (Korhonen *et al*. 2020). Additionally, Korhonen *et al*. (2020) point out that M2M can be used to track inventory and to optimise the supply chain.

Fieberg *et al*. (2022) explain that M2M improves auditing processes by allowing auditors to handle massive volumes of data, both unstructured and structured that would be hard to manage without the aid of M2M. In addition to increasing

the speed and accuracy of financial transactions, machine communication has also made it easier for accountants to access and analyse financial data. Algorithms are essential for unlocking the massive and increasing amount of financial data needed for accurate forecasting and strategic decision-making (Bertomeu 2021). With the use of online systems and cloud-based software, accountants can access financial data from anywhere and at any time, which has greatly increased their ability to respond to changing business needs and make informed decisions (Li and Vasarhelyi 2018)

Machine communication can help accountants ensure compliance with financial regulations and reporting requirements. Compliance requirements can be efficiently addressed by rules that are integrated into the software (SAICA 2018). For example, software programs can automatically check financial data for compliance with various accounting standards, such as Generally Accepted Accounting Principles (GAAP) or International Financial Reporting Standards (IFRS).

Machine communication makes it possible for different parties to work together and makes it easier for stakeholders to offer cloud services (Hussain, Anpalagan and Vannithamby 2017). Machine communication has made it easier for accountants to collaborate with colleagues and clients, regardless of location. For example, cloud-based accounting software allows accountants to access and share financial data in real-time, enabling them to work together more efficiently.

2.7.5 Artificial intelligence (AI)

Over the years, AI has evolved significantly, with advances in machine learning and natural language processing enabling the development of more sophisticated and effective AI systems. Artificial intelligence is being used in various business contexts, from automating routine tasks to providing personalised customer service and making strategic decisions (Diez-Olivan *et al*. 2019). One aspect of AI in business that has gained significant attention in recent years is the use of machine learning algorithms to process and analyse large amounts of data. Machine learning algorithms can identify patterns and trends in

data that may not be immediately visible to humans, and they can learn and adapt over time as they are exposed to more data (Ruiz-Real *et al*. 2021).

Artificial intelligence has the potential to transform a wide range of industries, from finance and healthcare to transportation and retail (Thesmar *et al*. 2019). In the finance industry, for example, AI can be used to analyse financial data and identify trends, enabling companies to make more informed investment decisions (Mullainathan and Spiess 2017). In healthcare, AI can be used to analyse medical records and assist with diagnosis and treatment plans (Thesmar *et al*. 2019). In transportation, AI can be used to optimise routes and improve logistics, and in retail, it can be used to personalise recommendations and improve customer service (Parveen 2018).

Machine learning is used in business for predictive analytics, which involves using data and machine learning algorithms to forecast future outcomes. Predictive analytics can be used in various contexts, such as forecasting demand for a product, financial forecasting, identifying potential customer churn and predicting equipment failures (Ruiz-Real *et al*. 2021). By using predictive analytics, businesses can make more informed decisions and take proactive measures (Neeli 2020).

He *et al*. (2017) suggest that another application of machine learning in business is natural language processing (NLP), which involves the development of algorithms that can understand and interpret human language. Natural language processing has many applications, including language translation, content recommendation, and customer service (He *et al*. 2017). For example, a company might use NLP to analyse customer feedback and identify common issues or complaints, enabling them to address these issues and improve the customer experience (Huang and Rust 2021).

Artificial intelligence powered chatbots and virtual assistants can provide quick and efficient responses to customer queries, freeing up human customer service representatives to handle more complex issues (Panda and Chakravarty 2022). This can improve the customer experience and build loyalty for the business. With the help of machine learning algorithms, AI systems can analyse customer data and provide customised recommendations that are tailored to an individual's

needs and preferences (Loring 2018). This can improve customer satisfaction and loyalty and drive sales and revenue for the business (Loring 2018).

There are also some ethical and regulatory issues related to the use of AI in business. For example, there are concerns about the potential for bias in AI algorithms, as they may be based on data that reflects existing societal biases (Siau and Wang 2018). There are also concerns about the accountability and transparency of AI systems, as they may make decisions that have significant impacts on individuals or organisations without human oversight (Siau and Wang 2018). Businesses implementing AI may face the need for specialised skills and expertise. Tizhoosh and Pantanowitz (2018) explain that developing and deploying AI systems requires a deep understanding of machine learning and data science, which may not be readily available within the organisation. Tizhoosh and Pantanowitz (2018) state that the application of AI may require businesses to invest in training and development or hire specialised talent. Muhuri, Shukla and Abraham (2019) conclude that AI has the potential to displace human workers, leading to job losses and other negative economic impacts.

2.7.5.1 How it impacts on accounting

Huang and Rust (2021) posit that accountant will be able to put all their education and experience to use by offering clients practical and successful business solutions, whether they are related to tax consulting, real estate transactions, growth option, mergers or any other aspect of business operations. Huang and Rust (2021) added that the time is now to learn the IT and database administration skills needed to advance in the future as technology is developing at an unprecedented rate. The accounting profession will become less demanding and laborious because of the advent of AI, which will allow accountants to devote more time and energy to providing valuable advice to their clients (Odoh *et al*. 2018).

The accounting profession can reap the benefits of AI technology since it allows for greater adaptability, lower costs, easier accessibility, and more individualised offerings (Lui and Lamb 2018). Conversely, Stahl and Wright (2018) posit that the implementation of AI may present novel difficulties, such as the need for

government oversight of financial advice offered by the algorithm, security, and privacy. Nicoletti, Nicoletti and Weis (2017) indicate that to meet the needs of their 21st century clientele who prefer the flexibility of online transactions, several financial institutions are beginning to implement FinTech and RegTech technologies into their offerings. FinTech (financial technology) refers to the use of technology to improve and automate financial services. RegTech (regulatory technology) denotes to the use of technology to support and improve regulatory compliance in the financial sector. Le Guyader (2020:3) points out that “AI functionality now can be asked to track the ongoing matching of the derivative to the hedged item and their required linkage, delivering risk management in addition to hedge accounting results, and measuring, reporting, and then controlling the income manifestations of imperfect hedges”.

Artificial intelligence can be employed to improve customer service by efficiently gathering chat logs to better respond to customers' requests for financial services (Lui and Lamb 2018). That is why it is crucial that artificial intelligence be used in the accounting profession to spur growth and innovation within the sector and boost the efficiency of businesses. With the help of AI, accounting professionals can finally overcome the burden of data capturing, errors and omissions thereby freeing up accountants to focus on more creative tasks that actually benefit the business (Zhu and Zhang 2018).

Carvalho and Almeida (2022) posited that prior to AI, accounting personnel manually prepared and processed delivery orders, purchase orders, and invoices on paper documents. Then, after being manually entered into computer systems, these documents were coded before being sent to the managers for approval and payment. As a result of AI, there is a reduction in manual processes since the automated process (AP) recognises, analyses and exports data into a company's financial system. Maintaining current knowledge of the newest accounting trends and innovative technologies is crucial for accountants (Andiola, Masters and Norman 2020).

Carvalho and Almeida (2022) elaborate that prior to the AP system, suppliers had limited access to real-time information on the timing of payments. Tiron-Tudor and Deliu (2021) argued that while it is undoubted that AI technology can

do many common accounting jobs more quickly and effectively and that these capabilities will only grow with time, it does not mean that accountants are going to be extinct. Tiron-Tudor and Deliu (2021) indicate that accounting professionals that can evaluate and comprehend AI data and offer consulting services will always be in demand by businesses. Instead of taking the place of an accountant, artificial intelligence will change the tasks they handle. Accountants will have more time to concentrate on other areas of their jobs, like consulting and data analysis, as AI technology and machine learning will manage many of the boring, repetitive chores (Kaur, Ganguli and Tripathi 2022).

Instead of spending hours on menial activities, accountants of the future will be able to access and evaluate AI data to provide sound business solutions to their clients (Kaur, Ganguli and Tripathi 2022). Artificial intelligence will help accountants improve their services in a variety of ways. Artificial intelligence technology will increase data entry accuracy while lowering accountants' liability risk. Chouiekh and Haj (2018) elaborated that developing technology is more effective at detecting fraud, providing an additional layer of security for accountants and their clients. It also gives accountants real-time data, allowing them to deliver real-time solutions (Chouiekh and Haj 2018). Even more astounding is machine learning's capacity to instantaneously assess vast volumes of data, evaluate past triumphs and failures, and accurately anticipate future outcomes.

2.7.6 Smart factories

Jerman and Dominici (2018) allude that smart factories are among the essential elements of Industry 4.0. Flynn, Dance and Schaefer (2017) explain that a smart factory is a manufacturing facility that uses advanced technology to optimise and automate production processes. Smart factories use of robotics, automation, data analytics, and the internet of things (IoT) to improve efficiency, reduce errors, and increase productivity. The key aspect of a smart factory is the use of data analytics and advanced sensors to monitor and control production processes in real-time (Jerman and Dominici 2018). Smart factory use of sensors to collect data about the performance of equipment and machines, as well as the use of data analytics to analyse this data and identify opportunities for

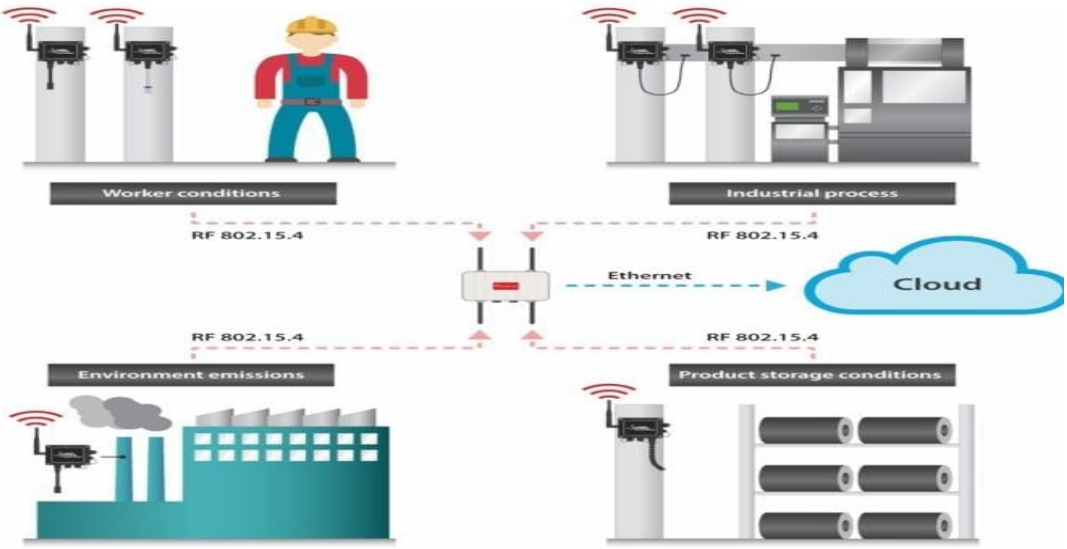
improvement (Ghobakhloo 2018). It aims to make use of innovative information and manufacturing technologies to give physical processes the flexibility they need to function in a highly dynamic market.

Smart factories rely on advanced technology and automation to reduce the need for human labour (Flynn, Dance and Schaefer 2017). That is, production in these factories is entirely handled by robotic systems. Kusiak (2018) elaborates that smart factories use advanced technologies to reduce waste and improve energy efficiency, which can help to reduce the environmental impact of manufacturing operations. Smart factories can be more agile and responsive to changing market conditions and customer demand, as they can quickly adjust production processes and reconfigure equipment to produce different products (Del Giudice *et al*. 2021). These processes are critical to the future of the manufacturing industry and will always have a sensitive place throughout the entire manufacturing cycle.

Virtual reality, augmented reality, simulations, and virtual prototyping are all related to smart factories. Sinsel *et al*. (2017) point out that by leveraging the power of technology and data analytics, smart factories can help businesses to improve their performance and stay ahead of the competition. These technologies enable consumers to see and learn about the future of products in the synthetic world before they are manufactured and introduced to the market. The products will be tested virtually concurrently with production runs, and the design features and some functionalities will be determined through purpose-based simulation runs (Klaus 2016).

Naturally, smart factories share some characteristics, as described by Remon (2017) and shown in Figure 2.2

Figure 2. 2 Smart factories



Source: Remon (2017)

As demonstrated above, there are four fundamental areas that appear to be undergoing change and integrating with one another. They are the circumstances surrounding workers, industrial processes, environmental emissions, and product storage. Radio Frequency Identification (RFID) and cloud technologies will be crucial to this flow. Components in smart factories will interact and communicate with one another well via the internet system.

2.7.6.1 How it Impacts on accounting

Smart factories will be able to transmit their technology to other facilities, allowing for better monitoring of product life and real-time profit estimation (Yürekli and Şahiner 2017). With smart factories, products can be modified, and new items can be designed using data collected throughout a product's lifespan (Huang *et al*. 2017). The collected data can be used to prevent the manufacturing of items that are not in high demand or for which there is not a need for a large supply of raw materials (Huang *et al*. 2017).

Table 2. 1 Smart factories and their effects on accounting

Cost-management accounting topics	The effects of dark factories (Industry 4.0)	
Direct Raw Material and Supply Costs	↓	Will show a decrease due to the decreases in product defects and wastages
Direct Labor Costs	↓	Will decrease as the distance between technology and human labor grows rapidly
General Production Costs	↑	Will increase due to the increment in deprecation costs and manager labor
Order Cost System	↑	Will increase with customer oriented production
Plant Cost Systems	↓	Will decrease with customer oriented production
Rate of Wastage	↓	Will decrease with Iot, intelligent warehouses and intelligent shelves
Waste Quantity	↓	Will decrease with Iot, intelligent warehouses and intelligent shelves
Production Quantity and Speed	↑	Will increase with 24/7 continuous production and automation
Production Errors	↓	Will decrease as the distance between technology and human labor grows rapidly
Fixed Costs	↑	Will increase with the increment in fixed assets and depreciation expenses
Changing Costs	↓	Will decrease with the decrease of energy sources and labor
Fixed Assets Investments	↑	Will increase due to mechanical, software, patents etc.
Management Labor	↑	Will increase due to the decrease in unqualified works and specializing on qualified work
Cut Taxes From Labor	↓	Will decrease with the decrease in the number of workers
Severance Pay	↓	Will decrease with the decrease in the number of workers
Working Hours	↓	Will decrease with automation and cloud communication
Productivity	↑	Will increase with the decrease in production errors and wastages
Break-Even Point[a] $BEP = \frac{\text{Total fixed cost}}{\text{Unit sale price} - \text{Unit changing cost}}$	↑	Will increase as a result of the invesments in fixed assets, as the increment of total fixed cost is more than changing costs
Reporting and Time of Making Decision	↓	Will decrease with Iot concurrent financial reporting
Clearness and Accountability	↑	Will increase together with concurrent financial reporting, making calculations of profit per unit possible

Source: Kablan (2020).

The table:2.0 summarises the impact of smart factories in accounting.

The emergence of smart and intelligent factories will allow for accurate cost estimation and efficient cost management, resulting in improved productivity without an increase in labour costs (Aslan and Ozerhan 2017). At the same time, it will be feasible for firms to determine both the unit price of the product and the profit margin on that price profit estimation (Yürekli and Şahiner 2017). Moreover, asset management is realised through the use of concurrent controls carried out

throughout production to alert the appropriate personnel in the event of any malfunction, theft, or misuse (Tao *et al*. 2018). Furthermore, Tao *et al*. (2018) suggest that smart and intelligent factories will offer businesses a competitive advantage in terms of time efficiency and reduced risk of making mistakes.

Smart factories rely on advanced technology and automation to reduce the need for human labour and improve efficiency. This can have implications for the way labour costs are accounted for and reported, as well as the way that overhead costs are allocated (Appelbaum, Kogan and Vasarhelyi 2018). This suggests that accountants may need to develop new approaches to cost accounting that take these changes into account. Smart factories use robots to handle tasks such as data capture, assembly, inspection, and packaging, as well as the use of automation to control and coordinate these tasks (Sinsel *et al*. 2017).

Jang and Jeong (2019) note that smart factories can use RFID chips to track inventories and mark products. However, the use of automation and robotics in smart factories can also have an impact on the way that inventory is managed and accounted for (Jang and Jeong 2019). For example, the use of automation may reduce the need for safety stock and may change the way that inventory is valued. Location-based data can be used to analyse stock levels in addition to tracking item codes with RFID tags that are attached in products (Jang and Jeong 2019). Accountants may need to adapt their inventory management and accounting practices to reflect these changes. The adoption of advanced technologies in smart factories may also increase the demand for accountants with technical expertise and skills in areas such as data analysis and automation. Accountants should safeguard their careers by constantly expanding their knowledge and skill set to remain relevant in an evolving corporate and technological environment (PWC 2017).

There are also some challenges that businesses may need to consider when implementing a smart factory approach. For example, implementing modern technology can be expensive and may require significant investments in infrastructure and training (Vajjhala and Ramollari 2021). In addition, smart factories rely on complex systems and technologies, which can require specialised expertise to maintain and troubleshoot (Appelbaum, Kogan and

Vasarhelyi 2018). The adoption of smart factories raises concerns about the impact of automation and robotics on jobs and employment in the manufacturing sector. Crnjac, Veža and Banduka (2017) note that the rise of digital design and manufacturing is affecting practices, procedures, and careers within businesses.

2.7.7 Internet of things

The Internet of Things (IoT) refers to the interconnected network of physical objects that are embedded with sensors, software, and other technologies for the purpose of collecting and exchanging data (Wu, Xiong and Li 2019). These objects, also known as "smart devices," are able to communicate with each other and with external systems over the Internet, enabling them to send and receive data and to be controlled remotely. These are the devices that are able to collect data about the physical world, such as temperature, humidity and motion (Karmańska 2021). They can also be used to control physical devices, such as turning on a light or opening a door. For IoT devices to communicate with each other and with external systems, they need to be connected to the Internet or to other networks. This can be achieved through various technologies, such as Wi-Fi, Bluetooth, cellular networks, or satellite networks (Yu *et al*. 2018).

Yu *et al*. (2018) posit that for IoT to reach its full potential, it is important that different devices and systems are able to work together seamlessly. IoT requires the development of standards and protocols that can ensure interoperability between different systems (Bello and Zeadally 2019). Some examples of IoT devices include smart thermostats, connected appliances, and wearable fitness trackers. These devices are able to gather and transmit data about their surroundings and their own operations, allowing them to be monitored and controlled remotely (Bello and Zeadally 2019). For example, a smart thermostat can be programmed to adjust the temperature of a room based on the preferences of the user and to turn it off when the room is unoccupied to save energy.

The IoT has the potential to transform many industries and aspects of daily life by providing new ways for people to interact with their environment and with each other (Sobin 2020). The IoT can be used to improve efficiency and productivity in manufacturing, transportation, and agriculture, as well as to enhance

healthcare, education, and financial institutions (Sobin 2020). However, the widespread adoption of the IoT also raises concerns about privacy and security, as the collection and sharing of large amounts of data can potentially be used to infringe upon individual's privacy and compromise the security of systems and networks (Tewari and Gupta 2020). As such, it is important to consider and address these issues as the IoT continues to evolve and become more prevalent in society.

2.7.7.1 How IoT affects accounting

(i) Managing the increased amount of data

The American Institute of Certified Public Accountants (AICPA) (2020) posits that the accounting industry is being heavily impacted by the increasing influence of IoT. Chen *et al*. (2019) suggest that the Internet of Things will alter the sources of transactional data that flow into various accounting systems. As a result, there will be a greater influx of data that will need to be incorporated into reporting systems. Plenty of this data will be provided in real-time and shown on dashboards to aid with decision making and planning (Wu, Xiong and Li 2019). This will pave the way for further automated technologies to assist with data processing and analysis.

(ii) Becoming an advisor

Wu *et al*. (2019) indicated that lately, the accountant's job has changed from performing manual tasks to offering professional advice on money-related issues such as tax preparation, money management, and analysis. IoT will give accountants a better opportunity to offer guidance by expanding the visibility of client finances and financial activity (Yao 2019). This information can aid professionals in knowing clients better and, as a result, in providing better advise.

According to Yao (2019) accountants will need to become more computer proficient as IoT grows. Caseware (2020) suggest that accounting and IT professionals will need to collaborate to decide what types of data to collect and how to do it because of the IoT. Therefore, accountants will be required to give their clients advice on how to adapt their systems to take the Internet of Things into account. Similarly, Marwedel (2021) put that the Internet of Things is all set

to transform accounting as it helps help in the automation of core processes by efficient collection and processing of information.

(iii) Better decision-making

Bakarich and Obrien (2021) posited that Accountants in advisory professions must make critical financial decisions on behalf of their clients. These selections are based on extensive data analytics, business practices, and market research. Accountants oversee developing growth strategies and ensuring the company's long-term viability. IoT, in conjunction with AI and cloud technology, can help accounting professionals in making sound business decisions (Yao 2019). Chen et al. (2019) stated that real-time data can be gathered by an IoT device and sent to cloud servers for AI-assisted data analysis and process automation. For instance, the IoT device can automatically communicate updates to the cloud regarding the most recent tax laws or governmental developments. Decisions can be made based on a deeper interpretation of the data (Tiron-Tudor *et al*. 2021).

(iv) Streamlining Accounting Operations

Cooper *et al*. (2019) argued that for the purpose of gathering financial data, various departments must work together during the accounting process. The departments gather this data, which is then physically or electronically submitted to the accounting departments for bookkeeping. However, any incorrect information or data transfer delay might impede the accounting process and result in false financial statements (Tiron-Tudor *et al*. 2021). Imagine how convenient it would be if the accounting team was informed instantly whenever any of the other teams made a financial transaction. For instance, when an office chair is bought, the admin department scans the chair's barcode and sends all the information to the accounting department's database (Cooper *et al*. 2019). As all payments, invoices, and bills would be received by the accounting professionals automatically, this would streamline the workflow for accounting (Cooper *et al*. 2019).

(v) Minimise auditing efforts

According to Demirkan, Demirkan, and McKee (2020), auditing is one of the accounting profession's most well-known procedures. Every company undergoes frequent internal audits to look for financial irregularities or fraud. However, quite a lot of businesses do not check their accounts until the audit is imminent. As a result, they are submerged in a massive paperwork. All transactions can be tracked and reported in real-time to the accounting department with the use of IoT (Demirkan, Demirkan and McKee 2020). Therefore, if you have made a transaction, purchase, or received money, the accountants are already aware of it. This considerably reduces the amount of work required for an audit by streamlining the accounting process (Nasirzadeh *et al*. 2022). The accounting process will be error-free because of this.

(vi) Efficient Workforce Management

Vermesan and Friess (2022) posited that every accounting business understands the need to manage accountants and monitor their operations. Furthermore, because accountants frequently meet with their clients, it might be challenging to stay up to date on their locations. The accountants want to monitor their progress in order to streamline their workflow and increase productivity. IoT enables accountants to monitor their productivity throughout the working day. Nasirzadeh *et al*. (2022) also pointed out that the Internet of Things (IoT) gadgets can tell you what time of day you were most awake and least productive. This enables you to plan your work correctly and make the most of each day. The company can receive this information instantly and monitor their performance accordingly (Van Niekerk and Rudman 2019). Employers can also view your health status through IoT and present you with benefits.

2.7.8 Data mining

Data mining is a process that involves the extraction of useful information from large datasets (Zong, Xia and Zhang 2021). It has been used in various industries, including business, for many years. The earliest references to data mining can be traced back to the 1960s when researchers at IBM used data mining techniques to analyse customer data and identify patterns that could be used to improve marketing efforts (Fayyad, Piatetsky-Shapiro and Smyth 1996; Saura 2021). In the 1980s and 1990s, data mining techniques were further

developed and refined and used more widely in business and other industries (Zong, Xia and Zhang 2021). In the early 2000s, the widespread adoption of the internet and the proliferation of digital data made data mining even more powerful and prevalent (Attaran 2017). The development of new technologies, such as machine learning and artificial intelligence, also helped advance data mining and its capabilities (Attaran 2017).

Today, data mining is used in many business applications, including customer relationship management, fraud detection, market analysis, and supply chain optimisation (Olson 2020). It is also used in other industries, such as healthcare, finance, and government (Bauder, Khoshgoftaar and Seliya 2017). Data mining has become increasingly important in business as organisations have become more reliant on data-driven decision-making. With the proliferation of digital data, businesses have access to vast amounts of data that can be analysed to identify trends, patterns, and insights that can inform business strategies and operations (Bauder, Khoshgoftaar and Seliya 2017).

Data mining is often used with other analytical techniques, such as machine learning and predictive analytics, to extract more valuable insights from data (Olson 2020). For example, data mining can be utilised to identify trends and patterns in data, while machine learning can be used to build predictive models that can help businesses to anticipate future outcomes or events (Han, Pei and Tong 2022). Data mining supports various business functions, including marketing, sales, customer service, and supply chain management (Han, Pei and Tong 2022). Data mining can identify customer preferences and behaviours, optimise marketing campaigns, and improve efficiency of supply chain operations (Bauder, Khoshgoftaar and Seliya 2017).

Data mining can help to drive innovation and economic growth. By extracting valuable insights from data, businesses can identify new opportunities for growth and innovation and develop new products and services that meet the needs and preferences of their customers (Cheah and Wang 2017). Data mining can help to drive economic growth and competitiveness. Another impact of data mining on society is that it can help to improve the efficiency and effectiveness of various industries and sectors. Malik, Abdallah and Ala'raj (2018) posit that data mining

can optimise supply chain operations, which can help reduce costs and improve efficiency. Data mining be implemented to improve the accuracy and timeliness of financial reporting, which can help to build trust and confidence in the financial system (Shamsudeen, Abdullah and Saat 2017). Altman *et al*. (2018) state that businesses collect and analyse increasingly large amounts of data which can impact on privacy and security of consumers. Mazurek and Małagocka (2019) allude that data mining can be used to identify and prevent cyber-attacks.

2.7.8.1 How it impacts on accounting

Data mining can help to improve the accuracy and reliability of financial reporting. Traditional accounting techniques are time consuming and risk producing inaccurate, outdated audit reports (Al-Sartawi 2020). By using data mining techniques to analyse data, accountants can identify and correct errors or inconsistencies in the data, which can improve the overall quality of financial reporting. Data mining can be useful when working with complex data sets, such as those involving multiple transactions over a long period of time (Gupta and Sikarwar 2020). Accountants can use data mining techniques to identify patterns and trends in the data that might not be immediately apparent when looking at the data manually. This can help them to identify problems or areas for improvement and make more informed decisions (Chen and Shen 2020).

Data mining offer regulatory authorities the ability to monitor business activities in real-time and profile market risks of participants (Zaarour 2017). Data mining can also be used to identify fraud or other illegal activities within an organisation. Chen and Shen (2020) suggest that by analysing financial data using data mining techniques, accountants can identify unusual patterns or transactions that may be indicative of fraudulent activity. This can help to protect an organisation's financial assets and reputation. Data mining allows businesses to identify patterns in their data in a short time that would have taken years to find using conventional methods (Chahadah, Refae and Qasim 2018).

Data mining can help to streamline and automate certain tasks, such as the preparation of financial statements or the identification of trends and patterns in data (Zaarour 2017). This can help to reduce the amount of time and effort that accountants need to spend on these tasks, freeing them up to focus on more

complex and value-added work. The deployment of data mining in accounting can help to improve the accuracy and timeliness of financial reporting. Chahadah, Refae and Qasim (2018) conclude that data mining is a technique that can be used to ensure that data is accurate and legitimate. Additionally, by using data mining techniques to analyse data in real-time, accountants can identify and address issues as they arise, rather than having to wait for the next reporting period to identify and correct errors. Jan (2021) explains that data mining can help to improve the accuracy and reliability of financial reports and can also help to build trust with stakeholders.

Data mining can also be used to improve the accuracy of financial forecasts and projections. Amani and Fadlalla (2017) show that data mining offers businesses the ability to accurately forecast the future financial position which supports better managerial decision-making and boost business competitiveness. By analysing historical data and identifying trends and patterns, accountants can create more accurate and reliable forecasts of future financial performance. This can help organisations to make better informed business decisions and can also help to improve the accuracy of financial statements and reports. Zaarour (2017) concurs that data mining helps show management the logical relationship and cause in a company's financial information, enabling them to take proactive measures to address the problem. Data mining can help to reduce the compliance burden on taxpayers. Data mining can help to reduce the amount of time and effort that taxpayers need to spend on complying with their tax obligations by automating certain tasks (SAICA 2018).

2.8 Literature review part B

This section focuses on a literature review related to the influence of Industry 4.0 on accounting practices, the opportunities and challenges presented by Industry 4.0 and the role of management in implementing Industry 4.0 in accounting.

2.8.1 The influence of Industry 4.0 on accounting

Earlier research confirms that automation and computerisation have contributed to the alteration of job responsibilities and duties of the accounting profession. As such, the accounting profession has been linked to computers since the beginning, and later technological advancements have significantly increased overall computer usage and broadened the range of tasks that can be automated. As such, the emergence of Industry 4.0 has been influencing accounting practices in many ways.

Financial institutions must fully capitalise on the potential presented by new technology to become digital and adapt to the dynamic business environment (Reinartz, Wiegand and Imschloss 2018). Kaya, Türkyılmaz and Birol (2019) state that with the aid of Industry 4.0, traditional accounting programs are anticipated to transform into real-time accounting apps. In addition to employing a cloud accounting application, real-time accounting activities will be possible due to remote access and automatic data input into the system (Kaya, Türkyılmaz and Birol 2019).

Furthermore, the accounting system on the IoT ecosystem will give stakeholders instant insight into the status of enterprises' ongoing activities. That way, accountants will be able to provide feedback to management whilst the operations are still ongoing, rather than when they have been done. Hacioglu (2020) points out that the IoT will enable many tasks to be carried out easily without humans in intelligent firms. Alwadi *et al*. (2017) indicated that implementing cloud accounting in the business increases visibility, flexibility and scalability in the inventory management processes.

Time and place considerations will not matter in the modern accounting systems because all computers will be connected through IoT (Schmitz and Leoni 2019). This means that soon, professionals will not need traditional

accounting departments because they may use cloud-based accounting software. Pertulisov, Smolina and Vodopyanova (2019) allude that by leveraging cloud-based systems, businesses can streamline their operations, improve their responsiveness to market changes, and adapt to the ever-evolving needs of their customers. Konovalova, Kuzmina and Zhironkin (2019) indicate that cloud technology has some shortcomings in terms of institutional restrictions connected to the inadequately regulated communication system between the professionals and cloud application providers.

The current state of technological development provides numerous opportunities to streamline the information-delivery process to businesses (Czegledy, Fedorenko and Zaichikova 2019). The widespread adoption of cloud computing can be attributed to the growing demand for increased flexibility and cost-effectiveness of cloud-based systems (Meghana, Mathew and Rodrigues, 2018). Cloud computing enables businesses to cut down costs while simultaneously providing them with access to digital resources (Czegledy, Fedorenko and Zaichikova 2019). Cloud computing provides a low-cost, constantly active space for data processing and storage (Zehir and Zehir 2020). Cloud-based storage will be essential for the accounting firms considering the vast amount of data they process. Li *et al*. (2020) explain that vast and diverse data can be processed, used, and stored using cloud computing. Moreover, cloud computing offers cost-effective ways to increase productivity, decrease costs, simplify infrastructure complexity, expand the workspace, and promote collaborative and remote working for accounting professionals (Li *et al*. 2020).

As a result, obtaining relevant and usable information as well as providing accurate and timely information to users would demand expertise (Badertscher *et al*. 2017). Accounting discipline will transform into "Accounting Engineering" alongside the development of Industry 4.0, which will necessitate the employment of professionals competent in system design and the application of technology (Gulin, Hladika and Valenta 2019). Increases in data volume, velocity, and variety coupled with rapidly changing technologies pose the issue of the conventional audit model's validity and applicability (Appelbaum *et al*. 2017). The way in which financial statements will be audited and delivered will be transformed by the disruptive nature of Blockchain-based smart contracts

(Rozario and Vasarhelyi 2018). Digitalisation in accounting will have an impact on tax advisors and accountants that operate in the financial sectors of businesses.

The skill sets and levels of proficiency that employers will look for in current and future accountants are also evolving with the advancement of Industry 4.0. Cotet, Balgiu and Zaleschi (2017) point out that with the surge of technological innovation and different ways of working, workers ought to be creative to reap the benefit associated with these technological developments. In addition, Cotet, Balgiu and Zaleschi (2017) believe that proactive thinking applied to emerging technology assesses how human capital engages with the innovative technological paradigm to quickly incorporate and manage change in the global economy. This new era of technological convergence will require new skills and a new language to leverage the benefits of these innovations and understand the consequences (Skilton and Hovsepian 2018).

Clients now anticipate limitless communication and increased accountability from businesses when procuring product and service (Zehir and Zehir 2020). Moreover, the use of social media has transformed how businesses can interact with their stakeholders (Debreceny, Rahman and Wang 2017). Therefore, accounting firms can now distribute their communications instantly in the format of their choice using different social media platforms. In the past, organisations relied on external parties to deliver their annual report (Lei, Li and Luo 2019). This was ineffective for many businesses because of the time, money, and effort required to manage the content (Debreceny, Rahman and Wang 2017).

Since the advent of digital communication technology platforms like social media, there has been a substantial transformation in how accounting information is used and disseminated (Basuony, Mohamed and Samaha 2018). Social media platforms give a company the chance to interact with its customers on a range of issues, such as financial performance of the business and accounting information disclosure (Amin, Mohamed and Elragal 2019). Moreover, Boylan and Boylan (2017) found that the stock prices of organisations that disseminated information through social media performed better those that did not by nearly ten percent. Additionally, Drake, Thornock and Twedt (2017) posit that the use

of social media by businesses to voluntarily disclose financial and non-financial information on the internet has recently become more common.

Blockchain has transformed to a modern technology ecosystem that includes the Internet of Things (IoT), robotics, artificial intelligence, and crowdsourcing from a secure monetary transaction system (Xu, Chen and Kou 2019). Among the sectors to which Blockchain would offer great advantages and radically change the existing paradigms might be accounting and assurance (Dai and Vasarhelyi 2017). The most significant advancement in accounting applications offered by Blockchain technology is seen as the transformation of the double-entry system into a triple-entry system, which is viewed as the unique function of the system (Gürünlü 2019). Triple-entry accounting is a modern and more effective approach to tackle the underlying problems of confidence and honesty plaguing existing accounting systems (Cai 2019).

Lee and Shin (2018) maintain that by improving transaction security and expediting transfers at lower costs, Blockchain can transform a significant number of existing traditional accounting services. It, therefore, provides the opportunity to help improve trust, privacy and transparency issues for relevant stakeholders (Mukkamala *et al*. 2018). Industry 4.0 promises to solve issues and inefficiencies associated with the conventional method of intermediation, including potential human errors, reflecting a shift to automation because human inputs are no longer required (Nofer *et al*. 2017).

Ghobakhloo and Fathi (2019) enunciate that one noteworthy advantage of technological advancements is the elimination of the need for sluggish, manual processes hence allowing accountants to spend more time on creating value to the business. Ghobakhloo and Fathi (2019) state that cloud technology has reduced the price of infrastructure support for businesses. Modern technology enables a more comprehensive review of business drivers, as well as the use of insight and actionable analytics to gain a competitive advantage (Gulin, Hladika and Valenta (2019). Richins *et al*. (2017) concur that significant advancements have improved processing speed and increased data storage capacity. The ability to work more quickly while also looking at more has a significant impact on how accountants work. Advancements include big data and cloud technology,

both of which have an impact on all enterprises, not just accountants (Richins *et al.* 2017).

Blockchains could deliver lower transaction costs and more open records of ownership for shareholders while allowing noticeable real-time observation of transfers of shares from one owner to another (Yermack 2017). Prewett, Prescott and Phillips (2020) suggest that although Blockchain's decentralised system gives coders and developers more latitude in achieving their goals, the lack of standardisation also restricts users in Blockchain from being able to collaborate and communicate effectively. Wiatt (2019) suggests that because Blockchain ledgers exist in multiple locations on nodes, they may be subject to various national or international jurisdictions, inconsistent with existing legal interpretations and tax laws. As much as Blockchain is offering opportunities for companies, it is important to note that there will be many challenges related to regulatory, technical, and adoption (Attaran and Gunasekaran 2019). The high degree of risks associated with the use of blockchain technology in accounting and finance has been shown by recent incidents of digital currency theft and cybersecurity breaches (Deshpande *et al*. 2017; Attaran and Gunasekaran 2019).

Carlsson-Wall *et al*. (2022) point out that the transformation posed by Industry 4.0 on the accounting profession comes with opportunities. Bonsón and Bednárová (2019) claim that technology has made it possible for accountants and finance teams to quickly produce and create value, influence how it is done, and convey the story of how it is achieved. The author posited that finance used to be solely concerned with costs, but today it can also help to value creation and value preservation. Accountants can benefit from software-as-a-service (SAAS) technology, which provides access to individual programs and is housed in the cloud. In addition to decreased infrastructure expenses, set-up costs are lower, and implementation speed is enhanced (Kim, Jang and Yang 2017). Kim, Jang and Yang (2017) suggest that cloud technology is also safe and enables for seamless updates. The degree of knowledge available significantly outweighs anything available on an On-Premises system, and modifications, such as adding new organisations, can be virtually instantaneous (Carlsson-Wall *et al*. 2022).

2.8.2 Opportunities presented by Industry 4.0 in accounting

Zhong *et al*. (2017) suggest that Industry 4.0 is synonymous with the creation of communicative and intelligent systems that interact between human to machine and machine to machine. This is facilitated by CPS which are made up of smart devices that can communicate directly, trigger activities, and autonomously control one another (Ibarra, Ganzarain and Igartua 2018). Ibarra, Ganzarain and Igartua (2018) illustrate that cyber-physical system is a multi-process system that combines communication, physical processes, and computation (Wang and Wang 2016). The IoT network allows CPS to communicate with one another using unique addressing patterns. Zheng *et al*. (2018) explain that the integration of the real and virtual worlds is a fundamental feature of Industry 4.0. additionally, Zheng *et al*. (2018) explain that Industry 4.0 is built on the vertical and horizontal integration of manufacturing systems, which is enabled through real-time data exchange and flexible manufacturing.

Industry 4.0 promises real-time control, integrated maintenance, improved adaptability and more collaboration across the supply chain (Li, Hou and Wu 2017). Thoben, Wiesner and Wuest (2017) conclude that it envisions that each physical object (for example, machines, components, or final product) is fitted with built-in digital technology that enables other objects and humans to interact. Having real-time data available at different places also helps with strategy and process design (Nagy *et al.* 2018). That is, the transaction is performed promptly and in real-time, ensuring that the outcome is instantly available. The massive amounts of data generated by smart devices enable the organisation to better understand its customers' needs and the specific tasks required to meet them (Thoben, Wiesner and Wuest 2017). Habeeb *et al*. (2019) elaborate that having real-time data available at different places also helps with strategy and process design.

Grabowska *et al*. (2020) explain that Industry 4.0 encompasses not just technical advancements but also change in business model, strategic planning, and supply chain management. The profitability and competitiveness of a company are directly linked to the business models that it adopts (Parida, Sjödin and Reim 2019). Therefore, the creation of innovative business models will ensure fast

process restructuring and agile production (Parida, Sjödin and Reim 2019). Creating a business model that can handle the challenges posed by Industry 4.0 is required because of the rapid growth of competition, which is mostly a result of globalisation (Grabowska and Saniuk 2022). A business model is directly connected to business operations and management.

With the aid of Industry 4.0, traditional accounting systems are predicted to become real-time accounting applications (Kablan 2020). The automated entry of data to the system and remote access may be provided along with the use of the cloud accounting software, and accounting processes will be real-time (Aazam, Zeadally and Harras 2018). Aazam, Zeadally and Harras (2018) posit that one of the many notable advantages of Industry 4.0 is collecting, processing, and disseminating data in a timely, easily accessible and transparent manner.

Faccia and Mosteanu (2019) highlight that the most significant advancement in accounting applications offered by Blockchain technology is seen as the transformation of the double-entry system into a triple-entry system, which is viewed as the unique function of the system. Triple-entry accounting offers a more efficient technique to overcome underlying transparency and trust challenges inherent in traditional accounting systems (Yürekli and Şahiner 2017). Both accounts can use the third public ledger to ensure that all three records are correctly captured and recorded (McConaghy *et al*. 2017). Furthermore, McConaghy *et al*. (2017) reveal that the asset's status change is automatically recorded in a shared ledger and made available to all parties involved. Blockchain-based triple-entry accounting could be a game changer (Deloitte, 2016). Blockchain has the ability to be a tamper-proof audit trail because of its consensus and encryption algorithm that ensure the integrity of transactions (Rozario and Vasarhelyi 2018).

Industrial revolution 4.0 has several beneficial effects for businesses and economic growth. Agostini and Nosella (2019) elucidate that the most frequently mentioned advantages of Industry 4.0 are increased production agility, customisation, smart products, improved quality, and enhanced efficiency. Implementation of Industry 4.0 is primarily motivated by its advantages, such as increased production and efficiency. Mai and Ninh (2017) note that automation

can minimise labour costs while increasing productivity levels with less mistakes, higher quality output and higher speed at the same time. Kiel *et al*. (2017) suggest that digital transformation of business activities would allow a quicker response to changes in the market.

Aksoy and Hacioglu (2021) indicate that faster and more accurate processing of accounting data is made possible by Industry 4.0 technologies such as robotics, AI, CAATTs, cloud databases, and Blockchain. Moreover, wearable technology such as smart glasses can improve accounting efficiency and effectiveness. For instance, an accountant can verify the existence of inventory in comfort his office using smart glasses without the need to go and physically count stock. Industry 4.0 has enabled the implementation of integrated audit software, that has improved the accuracy of audit reports, shortened times spent on auditing, and cut costs (Aksoy and Gurol 2021). Improved automation, enhanced connectivity, and self-monitoring of machinery are all made possible by the modern and emerging technologies of Industry 4.0. The IoT enables devices to perform the majority of tasks without human involvement, yet users can still engage with the machine.

Piccarozzi, Aquilani and Gatti (2018) explain that Industry 4.0 is not only about combining technology, but it is about the entire idea on how to share, own, use, regenerate, coordinate and reuse data, resources to make a product or provide a service quicker, cheaper, more effective and more sustainable for future consumer needs. Today, it is possible to control the flow of data coming from numerous sources and turn it into useful information to assist management in decision-making (Gökten and Özdoğan 2020). Real-time messaging platforms like WhatsApp, Facebook, MS Teams, WeChat, and Twitter have fundamentally altered how information is created and shared. Elliott, Grant and Hodge (2018) indicate that these social networking sites allow businesses to interact with their stakeholders in real-time and at an affordable cost. Lei, Li and Luo (2019) indicate that there has been a rise in the use of social media by business executives for the purpose of disseminating financial information and other business developments. Accounting firms can directly engage with their clients and communicate with them in real-time using social media thereby cutting out the need for traditional media outlets as conduits.

Kurt (2019) suggests that one of the most important conditions for realising the fourth industrial revolution is the completion of digital transformations by businesses. Industry 4.0 has introduced a range of new technological innovations that have altered the distribution methods of goods or services, thereby influenced existing business models and fostered new business models (Pereira and Romero 2017). For example, Nascimento *et al*. (2018) elaborate that in Industry 4.0, system convergence and sophistication would contribute to the development of more dynamic and digital business models, reducing the barriers between physical structure and information. In the financial sector, FinTech and RegTech companies are challenging the incumbents by launching innovative products and services and offering a new measure of competition (Arner *et al*. 2017). This has led to the transformation of accounting and financial services as well as creation of competition outside the traditional industry (Anagnostopoulos 2018). The term Fintech denotes the integration of finance and technology (Gai and Sun 2018). Arner *et al*. (2017) point out that Industry 4.0 is transforming how financial information is presented, transmitted, and analysed.

Financial Technology (FinTech) and Regulatory Technology (RegTech) companies leverage advanced technologies such as artificial intelligence, Blockchain, and big data analytics to streamline financial and regulatory processes, enhance financial inclusion, and ensure compliance with regulatory standards (Arner *et al*. 2017). FinTech companies offer a range of services including mobile payments, peer-to-peer lending, robo-advising, and crowdfunding platforms. These services have the potential to enhance the efficiency of financial transactions, reduce costs, and improve the accessibility of financial services (Zavolokina *et al*. 2019). In the context of accounting, FinTech innovations can automate routine tasks, enhance financial reporting, and provide real-time financial insights, thereby enabling accountants to focus on strategic decision-making (Susskind and Susskind 2016). However, RegTech companies focus on leveraging technology to enhance regulatory processes. They provide solutions for regulatory reporting, identity management and control, compliance, risk management, and transaction monitoring (Chishti and Barberis 2016). RegTech solutions can help accounting firms ensure compliance with changing

regulatory standards, reduce the risk of regulatory penalties, and enhance the transparency of their operations (Arner *et al*. 2017).

Organisations need to establish digital transformation plans to achieve fundamental business transformation, develop business projects and introduce information technology to ensure their survival from disruption (Aheleroff *et al*. 2021). As Reis *et al*. (2018) put it, for a company to realise a successful digital transformation it requires to develop thorough capabilities at different stages as required by the organisational perspective. The firms ought to have these abilities to reconfigure and change the governance, structure, systems and it is, therefore, important for management to make decisions about securing new resources and restore the existing ones (Rachinger *et al*. 2018). Digital transformation causes changes that impact a company's different aspects and requires the company to redefine its strategy, and, in turn, the organisation has to adjust its daily routines (Berghaus and Back 2017).

The effect of digital transformation often causes organisational structure and culture to change, leading to workers taking on roles that have historically been beyond their duties (Gallab *et al*. 2021). Implementation of the Industry 4.0 innovations results in the reduction of organisational barriers and fosters teamwork (Gallab *et al*. 2021). Moreover, literature has shown that digital transformation is generating instances in which workers who are not in the IT department are now heading technology-related ventures (Yeow *et al*. 2017).

The change in consumer behaviour often radically shifts their perceptions of the business, which in turn affects many industries (Lam and Law 2019). Moreover, Marwedel (2021) points out that organisations are experiencing a new age characterised by businesses that are becoming increasingly intelligent with data sharing, embracing the Internet of Things, and all of this is taking place at a massive scale and smart technologies. In view of these technological changes, there is a need to implement business models that can allow the necessary flexibility to achieve the necessary organisational transformation to comply with the evolving digital economy (Nwaiwu 2018). Moreover, the capability of the IoT and Cyber-physical systems will enable the automatic collection, interpretation, and analysis of financial data (Xu *et al*. 2018).

2.8.2.1 Challenges presented by Industry 4.0 in accounting.

Industry 4.0 technologies, such as artificial intelligence, machine learning, and the IoT, require a level of technical expertise that many accountants may not currently possess (Kruskopf *et al*. 2020). Accountants may need to invest in training and education to acquire the necessary skills to utilise these technologies. Industry 4.0 technologies generate large amounts of data, and accountants will need to be able to analyse and interpret this data to make informed decisions (Ghani and Muhammad 2019). Hoffman (2017) states that Industry 4.0 technologies may require specialised software and a strong understanding of statistical analysis and data visualisation techniques.

Industry 4.0 technologies rely on algorithms and other forms of code, and accountants will need to have a basic understanding of programming to use these technologies effectively (Ghani and Muhammad 2019). Accountants may need to develop skills in languages such as Python or R. Additionally, Industry 4.0 technologies require specialised training and education, which can be expensive (Tortorella *et al*. 2020). Learning new technologies and techniques can be time-consuming, and accountants may struggle to find the time to invest in their development while also meeting the demands of their job. Ghani and Muhammad (2019) allude that there may be a lack of resources and support available to help accountants develop the skills they need to adopt Industry 4.0 effectively.

The laws and regulations can vary depending on the specific technology being used and the industry in which it is being applied. Ducas and Wilner (2017) suggest that there are particular laws and regulations related to using artificial intelligence, data protection and privacy, and cybersecurity. These regulations may impact the adoption of Industry 4.0 by accountants. As Industry 4.0 technologies continue to evolve and spread across different industries, different laws and regulations may conflict with one another. Allen *et al*. (2019) opine that there may be regulatory issues due to the lack of clear guidance and standards on the use of Industry 4.0 technologies. In some instances, the laws and regulations surrounding Industry 4.0 technologies may be vague and incomplete (Allen *et al*. 2019). This may make it difficult for accountants to understand their

obligations and ensure compliance. Gailani *et al*. (2020) elaborate that the lack of resources and capacity to enforce these laws effectively can make it difficult for accountants to ensure that they comply.

The issue of legacy systems is a significant barrier to the adoption of Industry 4.0 for accountants. Agostini and Nosella (2019) elaborate that integrating Industry 4.0 technologies into existing systems and processes can be challenging for businesses. Many businesses, including those in the accounting industry, have long-established systems and processes that may not be compatible with Industry 4.0 technologies (Sinsel, Riemke and Hoffmann 2020). Accountants may find it difficult to effectively adopt and utilise these technologies, as they may need to overhaul or replace their existing systems fully to leverage the benefits of Industry 4.0. Implementing Industry 4.0 technologies often requires significant investment in new hardware and software, as well as training and support (Moraes Silva, Lucas and Vonortas 2020). Integrating Industry 4.0 technologies into existing systems and processes can be complex and time-consuming, and it may disrupt business operations (Wuni and Shen 2020). This can be challenging for accountants, who may need to continue performing their duties while also adapting to the new systems and processes.

Industry 4.0 technologies rely on collecting and analysing large amounts of data, making them vulnerable to cyber-attacks. Adopting Industry 4.0 technologies creates risks for businesses, including those in the accounting industry, which may be targeted by cybercriminals seeking to steal sensitive data or disrupt operations (Mohi-ud-din *et al*. 2020). Challenges may be related to the lack of expertise and resources available to address cybersecurity concerns (Bag *et al*. 2021). In some cases, businesses may not have the necessary in-house expertise or resources to effectively address cybersecurity threats, making it difficult for accountants to protect their systems and data. Many laws and regulations related to cybersecurity have specific requirements that businesses must follow to protect against cyber threats (Lezzi, Lazoi and Corallo 2018). Failure by firms to comply with these requirements can result in significant fines and penalties.

The adoption of Industry 4.0 often requires significant hardware, software, and training investment, which can be a financial burden for small and medium-sized businesses (Ghobakhloo and Iranmanesh 2021). A study by Javaid *et al*. (2022) found the high initial cost of implementing Industry 4.0 to be a barrier to adoption. For small accounting firms, the cost of implementing Industry 4.0 technologies may be a significant barrier to adoption. Horváth and Szabó (2019) elucidate that small businesses may have limited resources and expertise, making it challenging to implement and utilise Industry 4.0 technologies. Accountants may find investing in additional training and support to use these technologies challenging. Ansari, Glawar and Nemeth (2019) explain that adopting modern technologies requires changes to business processes and operations, which can be disruptive, particularly for smaller businesses. Accountants may need to adapt to these changes while continuing to perform their duties.

Organisation culture can present a challenge for accountants in adopting Industry 4.0, as it refers to the shared values, beliefs, and behaviours that shape an organisation's operations. Culture can influence an organisation's willingness to embrace modern technologies and processes (Leso, Cortimiglia and Ghezzi 2022). Organisations with a culture that is resistant to change are less likely to provide the necessary resources and support for the successful implementation of Industry 4.0 technologies (KPMG 2019). An organisation's culture that values stability and tradition may struggle to adopt Industry 4.0 technologies (PWC 2020). Cohen *et al*. (2020) elucidate that organisational culture can affect how accountants work and interact with other departments and stakeholders. McKinsey and Company (2020) conclude that organisations with a culture that is hierarchical or top-down may struggle to engage and motivate employees to embrace Industry 4.0 technologies. The support and buy-in of employees are often critical to an organisation's change initiatives.

Organisations operating in highly competitive markets may feel pressure to adopt Industry 4.0 technologies to remain competitive (KPMG 2019). This can present a challenge for accountants, as adopting these technologies may require a significant investment of time and resources. Organisations with limited resources or expertise may struggle to adopt Industry 4.0 technologies (PWC 2020). The organisation environment can also impact the adoption of Industry

4.0 by shaping how employees respond to change. Organisations operating in rapidly changing environments may be more open to adopting Industry 4.0 technologies, while organisations operating in more stable environments may be more resistant to change (Deloitte 2020). This can present a considerable challenge for accountants, who may need to overcome resistance to change and ensure that employees are on board with adopting Industry 4.0 technologies.

Organisations that can effectively adopt Industry 4.0 technologies often have strong leadership that can provide vision and direction, set clear goals and objectives, and create a culture of innovation and continuous improvement (KPMG 2019). Without strong leadership, the adoption of Industry 4.0 technologies may be hindered, as there may be a lack of direction and support for these efforts. The adoption of Industry 4.0 technologies often involves changes to business processes and operations, and there may be resistance from employees and other stakeholders to these change initiatives (McKinsey and Company 2020). Strong leadership is necessary to overcome this resistance and ensure that employees are committed to adopting Industry 4.0 technologies. Organisations that are able to allocate the necessary resources and expertise are more likely to be successful in adopting these technologies (PWC 2020). Leadership must be able to identify the resources and expertise needed and ensure that they are available to support the adoption of Industry 4.0 technologies.

Gulin *et al.* (2019) analysed the key challenges that digitalisation brings for the accounting profession and found that the accounting profession is faced with the use of big data in accounting and reporting, cloud computing and continuous accounting, artificial intelligence, and Blockchain technology. The study highlighted that technological advancements and digitalisation will have a substantial impact on the accounting profession in the next years. Gulin *et al.* (2019) elucidate that changes include daily reporting, a shift in how business and strategic goals are developed, the deployment of a digital wallet and online accounting, and the outsourcing of accounting to foreign countries.

Gulin *et al.* (2019) indicate that due to increasing digitalisation of business, the educational system will alter. In addition, accounting information users in the

digital era are changing; they expect accounting information at once after a business event occurs, rather than with a time lag. These developments will have an impact on how accountants do their duties, necessitating the acquisition of new skills, particularly in engineering, and, ultimately, will result in new kinds of accounting professionals.

The emergence of Industry 4.0 is expected to bring significant changes to the accounting landscape, necessitating alterations in the accounting educational curriculum and skills. These changes will be crucial in preparing future accountants for the evolving demands of the profession and will also have implications for accounting firms. The accounting curriculum will need to be updated to incorporate new technologies and systems associated with Industry 4.0. This includes teaching students about data analytics, artificial intelligence, Blockchain, and other digital tools that are becoming increasingly important in accounting (Bai and Sarkis 2020). Furthermore, the curriculum should also focus on developing students' understanding of how these technologies can be applied in accounting practices. This could involve case studies, practical exercises, and other hands-on learning experiences.

In addition to technical skills, future accountants will also need to develop a range of soft skills to navigate the changing accounting landscape. This includes critical thinking, problem-solving, and communication skills, which will be essential for interpreting and conveying complex financial information in the context of Industry 4.0 (Bai and Sarkis 2020). Additionally, skills in areas such as cybersecurity and data privacy will also become increasingly important, given the reliance on digital technologies in Industry 4.0.

The changes in the accounting educational curriculum and skills can also have implications for accounting firms. With a workforce that is well-versed in Industry 4.0 technologies, firms will be better equipped to adapt to the changing accounting landscape and offer more sophisticated services to their clients. However, this also means that firms will need to invest in ongoing training and development to ensure their existing employees are not left behind (Bai and Sarkis 2020). In addition, Bai and Sarkis (2020) emphasised the importance of integrating Industry 4.0 technologies into the accounting curriculum and

highlighted the need for a shift in focus from traditional accounting practices to more innovative, technology-driven approaches. They also noted that this transition would require significant effort from educators, students, and professionals in the field.

Mpofu and Nicolaides (2019) note that technology brought Industry 4.0 is increasingly replacing low skill jobs. Baev *et al*. (2020) noted a correlation between increased demand for skilled workers and technical advancements and increased productivity. Baev *et al*. (2020) that tasks requiring low technical abilities typically require low-medium skills, which can be easily automated due to their repetitive nature. According to Guo *et al*. 2021, the adoption of modern technologies will result in increased customer readiness to receive information, an increase in the use of electronics for tax purposes, and a shift in the frequency of audit. Thus, despite its complexity, technology sometimes requires low or medium-level abilities that are uncommon in the accounting profession.

Tribunella and Tribunella (2016) investigate as of 2005, the disparities in practitioner and academic interest in developing accounting-related technology. The most recent technological trend in the accounting Industry is the subject of conflicting opinions from academics and practitioners. Young accountants need to improve their technology abilities in addition to being skilled graduates.

A study conducted by Pulakanam and Suraweera (2021) in New Zealand shows that implementing Industry 4.0 technology in the accounting business is a challenge since lots of resources are needed for training the stuff. Using interpretive approach based on a qualitative research methodology they found out that accountants have a key part to play in technology and they must be taught how to make the most out of it. Not everyone will grasp using modern technology in a short period and businesses must allow for this. They should empower staff to try it out and eliminate any fears of failure. The study has established user confusion, lack of external guidance and support, and lack of accounting skills have been identified as major issues faced by many small businesses in implementing SBA software for in the accounting business (Pulakanam and Suraweera 2021).

Ghobakhloo and Fathi (2019) point out that Accountants are rapidly straying from bookkeeping and stewardship in favour of becoming business strategic partners due to technology. Routine and process-driven jobs will become less common, while creatively challenging jobs will become more in demand. Overall, accountants have caught on to the "inexorable wave" of technology, but the problem is finishing day jobs in time to bring about the change of the future. The frenetic nature of many people's daily schedules makes it impossible to consider alternative working arrangements.

2.8.3 The role of management in implementing Industry 4.0 in accounting business

(i) Creating vision, goals, and objectives for change

Businesses in the age of Industry 4.0 are under immense pressure to undergo digital transformation if they want to thrive and remain relevant. It is the duty of leaders to effect real change within the company while overcoming obstacles (Cortellazzo, Bruni and Zampieri 2019). However, digital transformation is an emotional process since no one likes to change. Digital transformation often involves changes to established routines and ways of working. This process of adaptation can be emotionally challenging. The adoption of Industry 4.0 necessitates meticulous planning at all stages.

A vision statement outlines or captures the team's shared goals, incorporates its core values, articulates the firm’s vision and objectives, but also inspires subordinates to stick with it (Cortellazzo, Bruni and Zampieri 2019). Additionally, subordinates are more likely to implement change if the leader has a clear vision for the future that outlines the goals and how these targets may be met while also easing the difficulties associated with managing change (Goleman 2017). In addition, Goleman (2017) posit that leaders enlist the help of their teams and the interest of different stakeholders by painting a picture of the organisation's positive future. The firm leadership could explain to employees the opportunities of implementing Industry 4.0. A vision is important for the change initiative and for the firm. a vision for change has been found to be more important in supporting management of change as it supports the policies and methods of change initiative (Kane *et al*. 2019).

To develop and implement a strategy, strong leadership is essential. Kane et al. (2019) opined that top management serve as a connection that binds different departments of the institution together. Therefore, leader's commitment is what motivates the organisation to succeed, and this success results from making wise choices by creating and implementing appropriate strategies (Goleman 2017). Excellent strategies lose their significance if they are not executed perfectly. Senior management provides guidance on how firm strategy is carried out and the best course of action (Simons 2019). In addition, Simons (2019) suggests that firm leadership also use different techniques to reflect, make plans, and supervise operational activities. Trevino and Nelson (2021) explain that top management try to tailor their organisation to the requirements of the environment.

Most of the time, effective leaders in businesses perform the routine duties involved in formulating and implementing strategies (Nelson 2021). They create a vision and strategy, establish goals and objectives, build the plans, put them into action, and then assess the outcomes (Fernandez *et al*. 2019). However, employees are emotional creatures, and change is seldom without some type of emotion. But when something changes, this sense of security is upset, leaving the change recipients feeling uncertain and uneasy (Anderson 2019). Furthermore, Anderson (2019) elaborates that people usually respond with emotions whenever change affects matters that are important to them because they are afraid of the uncertain future. For example, implementing Industry 4.0 in an accounting firm will affect how accountants execute their duties which can cause a negative reaction towards the technology. In order to introduce change in a company, it is essential to create an environment where communication is unrestricted (Bucăţa and Rizescu 2017).

(ii) Communicating change

The implementation of modern technology is a process that requires dedication and open communication from senior management. This may entail top management committing to new values, organising the necessary resources, and communicating with employees about the scope, and level of commitment expected for the implementation to take place (Katsikas, Rossi and Orelli 2017).

Planning for a large-scale organisational transformation is essential at this phase (Sulkowski, Edwards and Freeman 2018).

Senior management handles disseminating information about Industry 4.0 adoption. Change would only be possible with effective communication and engagement with stakeholders (Katsikas, Rossi and Orelli 2017). It is also important for senior management to show open and consistent backing for the change, as this serves as an example for subordinates (Andriof and Waddock 2017). Implementation of Industry 4.0 cannot happen if there is no clear buy-in from upper management. Because subordinates often imitate the actions of the leader. Sulkowski *et al*. (2018) point out that employees may be hesitant to participate in change projects if they feel intimidated by the proposed change initiative. For instance, the adoption of Industry 4.0 in accounting may lead to the automation of some tasks previously performed by humans. It is essential to constantly communicate with the employees about upcoming changes, especially if they may affect how they do their jobs or the tools they use (Andriof and Waddock 2017). Regardless of whether the proposed change is abrupt, it is still important to take the initiative to share it with your employees (Deszca, Ingols and Cawsey 2019). Sometimes, all it takes to motivate workers is for them to understand that the firm is trying, and this averts any resistance due to misinformation.

Communication strategies within the accounting firms can either encourage or stifle the implementation of Industry 4.0. Deszca *et al*. (2019) explain that leadership actions may promote technological innovation by creating a culture that welcomes and supports innovative ideas that contribute to the achievement of the company's fundamental mission and vision. To establish a capable executive team that can articulate the company's future, it is crucial for top leadership to explain the value of technology to their subordinates, reward technological innovation, and do these three things (Baker 2012: Kotter 2017).

The successful implementation of change inside an organisation relies heavily on the establishment of an atmosphere that encourages open lines of communication (Xu, Stienmetz and Ashton 2020). Therefore, for Industry 4.0 to be successfully implemented, a communication-free environment must be

created by the firm leadership. Xu, Stienmetz and Ashton (2020) state that the concepts of commitment and open communication are central to the technology adoption process. Therefore, it might entail senior management committing to new norms, mobilising the necessary resources, and managers and staff communication regarding the necessity, scope, and dedication needed to complete the project (Dong *et al*. 2017). A leader's encouragement of staff to produce new ideas could be one way to boost innovative behaviour.

(iii) Allocating resources

The performance of an organisation may be improved by investing in the welfare and empowerment of its employees, who are the backbone of every business (Katsikas, Rossi and Orelli 2017). Therefore, essential skills and knowledge are required at each stage of the transformation process for the successful implementation of any technology in an organisation (Katsikas, Rossi and Orelli 2017). Organisational leadership allocates adequate resources, minimises resistance, and encourages a constructive attitude toward introducing and using modern technologies (Salum and Abd Rozan 2017). Guynamant (2017) indicates that senior management frequently neglect to invest the effort and money required to evaluate important procedures, create efficient hiring and compensation schemes, and grow their staff.

For staff to succeed in their new position, senior management must allocate funds for training and mentoring programmes (Guynamant 2017). This is because employees' way of thinking needs to adapt to a new way of doing work after the adoption of Industry 4.0. Leaders often do not put in the resources required to facilitate efficient recruitment and compensation structures and nurture their staff (Kärnä 2017). An organisation stands to gain much from adopting Industry 4.0, but only if it recognises the significance of investing in its people to boost the shared vision at every level (Kärnä 2017). Prospects for professional growth are a proven way to boost morale in the workplace.

Senior management must demonstrate a continuous dedication to the adoption of Industry 4.0, and they must back up their support for the change with adequate resources. Ahmad and Cheng (2018) explain that initiatives that show management's dedication to change enhance support for the change and lessen

employee uncertainty. The capability of staff to adapt to new work environments improves when top management provides them with the resources they need (Ahmad and Cheng 2018). However, effective communication between management and employees can help mitigate the lack of resources since workers may view doing so as a positive response to addressing an unsatisfactory work environment during change (Guynamant 2017).

Leaders in organisations oversee boosting organisational performance, reducing the perceived performance gap, and pursuing new business opportunities through the adoption of new technology (Gangwar, Date and Ramaswamy 2015). Top management must dedicate the necessary resources, avert internal resistance, and promote a positive outlook on the adoption and implementation of technology (Oliveira, Thomas and Espadanal 2014; Salum and Abd Rozan 2017: Rowles and Brown 2017). The adoption and implementation of technological innovation require the support of senior management. A senior management attitude of mistrust in modern technology can be harmful and may foster scepticism when implementing new technology (Rowles and Brown 2017).

(iv) Motivating employees

It is the responsibility of the leadership to properly guide the employees in conducting organisational tasks (Mansaray 2019). For the firm's goal to become a reality, leadership must motivate and encourage all members of the organisation to collaborate (Engle *et al*. 2017). The ability of the leadership to influence the group that change is necessary is crucial in every circumstance involving change (Mansaray 2019). The degree to which followers embrace modern technology depends on how well leaders can explain why the old one is not working (Cameron and Green 2019). Therefore, top management must explain to employees and other stakeholders why implementing Industry 4.0 is better technology than the one they are currently using.

Engle *et al*. (2017) believe that top management promotes programs that increase motivation and morale, which in turn boosts the staff' productivity. Gaviria-Rivera and López-Zapata (2019) indicate that firm leadership can inspire their teams to perform at a higher level by appealing to their subordinates' emotions and accomplishments. Senior management has a major bearing on the

morale within a company (Gaviria-Rivera and López-Zapata 2019). The adoption of Industry 4.0 may be improved by investing in the welfare and empowerment of its employees, who are the backbone of every business. Moreover, leaders who try to bring about change on their own are more prone to be alienated in their efforts, which could lead to failure (Salum and Abd Rozan 2017). Therefore, a leader's duty, then, is to assemble a victorious alliance.

To successfully implement Industry 4.0, teams must work together to create a shared vision, disseminate that vision to a wide audience, deal with resistance, and incorporate the changes within the firm's culture (Kotter 2012: Shao *et al*. 2021). As an organisation undergoes transformation, stakeholders may be hesitant to actively support the new direction. Gaubatz and Ensminger (2017) suggest that change initiatives may be jeopardised by some employees' opposition to change, which may be motivated by resentment that their contributions to the organisation will not be appreciated. Senge (2017) reveals that leaders can inspire their teams to perform at a higher level by appealing to their subordinates' emotions and accomplishments.

In addition to the organisation's mission, the attitude of urgency might cause senior management to lose the discipline necessary to get the task done (Senge 2017). A firm's vision cannot be realised if leaders act too quickly and leave their people behind (Sanders 2017). Rapid changes can cause turmoil and uncertainty, send inconsistent messages about how the company culture will change, and frequently trigger new organisational crises (Sanders 2017). In addition, Hsu, Li and Sun (2017) point out that successful leaders, ultimately, are those who take into consideration the aspirations and priorities of their members in order to foster a group with a shared set of values that can then be used to generate a shared strategy. To be successful, change agents need to cultivate positive relationships with all the different stakeholders present in a company (Hsu, Li and Sun 2017).

Motivation of staff to work together to achieve an organisation's purpose is a talent that requires skilful leadership (Linuesa-Langreo, Ruiz-Palomino and Elche-Hortelano 2018). Linuesa-Langreo, Ruiz-Palomino and Elche-Hortelano (2018) explain that without proper management in place, employees are free to

go about their day as they see fit, wasting valuable company time and resources in the process. Moreover, the hallmark of effective leadership is the capacity to inspire one's team and other stakeholders to enthusiastically embrace the firm's strategic goals and objectives (Groysberg *et al*. (2018). Groysberg *et al*. (2018) show that motivating elements are crucial in assisting workers in performing to the best of their ability and maintaining concentration. Therefore, understanding how to inspire employees is critical to achieving successful implementation of Industry 4.0.

2.9 Literature review part C

This section deals with a literature review related to the factors influencing accountants to implementing Industry 4.0. In addition, the section also discusses literature related to the cybersecurity risks associated with Industry 4.0 implementation in accounting.

2.9.1 Factors that influence accounting firms to adopt Industry 4.0 technology.

The acceptance of technology by individuals marks a significant move before any technology is used (Morosan and DeFranco 2017). The effectiveness of the system can only be realised when the end users actively engage with and make use of the information system (Zeiss *et al*. 2021). Stakeholders' resistance to modern technology would increase the organisation's loss of effort, time and costs paid by the organisation for the introduction of technology, which in turn contributes to its inability to benefit from that technology (Salloum and Al-Emran 2018). Zeiss *et al*. (2019) suggest that investment in any modern technology is costly and requires considerable effort and time. Vardarlier and Zafer (2020) point out that software project failure rates remain high despite their acceptance.

Aboelmaged (2018) indicate that the learning and sharing of information had a substantial positive effect on perceived ease of use and perceived usefulness of technology. For example, a study by Jabbar *et al*. (2021) on the impact of WhatsApp on employees in higher education found that employees were more likely to use WhatsApp as it allows easy and faster communication. Real-time social media sites promote user feedback, expand conversations, enhance or establish social relationships between a firm and its stakeholders, and send out prompt notifications to those who might be interested. With the advent of social media, it is now much easier to create and disseminate corporate content on the web. According to Ding, Zhou and Li (2020) businesses are increasingly using social media to share their finances information and annual reports. Therefore, social media presents an opportunity for accountants to communicate and receive instant feedback from clients and other stakeholders.

Delgado *et al*. (2019) posit that awareness and knowledge among workers and other stakeholders are needed for the effective adoption of technology. These

suggest that a change in the structure of a company can affect a company's work culture (Fogarty *et al*. 2020). An organisation that is unable to account for the cultural change as a result of technology can cost the organisation time, resources and employees that are frustrated or unable to function in a conflicting system (Fogarty *et al*. 2020). These changes will require training or recruiting new employees. Wage inflation can be driven by the high demand for qualified software developers.

Wong *et al*. (2020) explain that the right infrastructure and resources is needed before the adoption of modern technology. This infrastructure requires digital processes that allow an organisation to interpret the environment, demonstrate the reactions required, assess competitors' consumer needs and threats, and make the appropriate decisions when necessary. The common tangible challenge encountered by businesses is access to resources as technology becomes obsolete (Burch and Mohammed 2019). For example, conventional fixed algorithms have become inefficient in fighting rapidly changing cyberattacks (Binny *et al*. 2022). These cyber-defence mechanisms ought to be flexible, adaptable and resilient, capable of identifying a wide range of threats and making good decisions in real-time (Met *et al*. 2020).

Cyber security and data protection are seen as the essential features for Industry 4.0 implementation (Culot *et al*. 2019). In light of this, successful integration of production systems without data protection would not be feasible (Culot *et al*. 2019). Holdbacks resulting from fear of cyber-attack would decrease the company's willingness to share data and decrease the communication between activities Ku (2020). Quader and Janeja (2021) explain that cyber-attack causes a loss of reputation, loss of customer and financial loss for businesses, loss of trust, loss of privacy, and financial loss for customers.

The introduction and adoption of modern technologies is complicated by outdated business regulations (Yang and Li 2018). The development of information systems require appropriate legislation. These regulations could be copyright and legal laws that protect new products, trademarks and company logos (Iqbal and Yadav 2020). Due to security and regulatory issues, the process of digitalisation could be hampered (Sorkun 2020).

Salloum *et al*. (2018) explain that resources are needed before the adoption of modern technology. In light of this, the successful integration of production systems without data protection would not be feasible (Varela *et al*. 2021). Moreover, the introduction and adoption of modern technologies are complicated by outdated business regulations (Volkodavova *et al*. 2019). These regulations could be copyright and legal laws that protect new products, trademarks, and company logos (Iqbal and Yadav 2020). Due to security and regulatory issues, the process of digitalisation could be hampered (Sorkun 2020). Therefore. the implementation of Industry 4.0 technologies may be facilitated by advancements in governmental legislation and technology infrastructure (Rajet *et al*. 2020). Because of the strength of the government and other external influences, a highly institutionalised sector puts pressure on regulatory structures and regulatory bodies to implement practices that are compatible with their expectations (Adjei *et al*. 2021).

Environmental conditions and regulations, especially those related to government regulations and incentives might influence the organisations' decision to adopt technology (Clohessy, Acton and Rogers 2019). The adoption and success of technology is not determined by the organisation alone, but also by the regulatory authorities that develop laws to regulate technology (Sherer, Meyerhoefer and Peng 2017). The regulatory authority may be a local or global body. Technology regulators in some sectors require the technology to be certified first before it is adopted or implemented. The ability of an organisation to implement an invention would be enhanced if it received regulatory support for a reliable infrastructure (Kandil *et al*. 2018). Clohessy and Acton (2019) state that regulatory support had no considerable influence on businesses adopting cloud computing.

The introduction of modern technologies results in considerable changes in work patterns, and resistance to change is a common organisational response (Kim and Koo 2017). Maisiri, van Dyk and Coeztee (2021) elaborate that with more businesses worldwide adopting Industry 4.0 technologies, it becomes increasingly important for firms in South Africa to do the same to remain competitive on the global stage. Ocloo *et al*. (2020) opine that firms that do business with trading partners who have adopted Industry 4.0 technologies

expect their partners to be able to keep up with them in terms of technological capabilities. Ilin, Ivetić and Simić (2017) explain that as businesses become more connected to the global economy, there is increased pressure on firms to adopt technologies that their international trading partners use. The adoption of these technologies can help them easily communicate and collaborate with their partners, as well as ensure that they meet international standards and expectations. Lin *et al*. (2018) concur that as businesses and individuals become accustomed to using advanced technologies in their daily lives, they may expect their accounting firms to be able to offer similar capabilities. Technology adoption by accountants will be encouraged by the perceived benefits of Industry 4.0.

Organisational executives handle increasing organisational performance, closing the perceived performance difference, and pursuing new business prospects through the implementation of new technology (Hussain *et al*. 2018). Firm leadership must allocate the required resources, limit resistance within the organisation and foster a constructive attitude regarding innovation adoption and implementation (Salum and Abd Rozan 2017). Support from senior management is critical during the adoption and implementation of technological innovation. The attitude of mistrust in new technology at the senior management level can be harmful and might foster scepticism when implementing new technology (Rowles and Brown 2017).

Salah, Yusof and Mohamed (2021) indicate that the size of a company is a significant predictor of technology adoption. Larger businesses have been found to be more likely to implement modern technology because they have the financial resources and expertise to do so, as well as economies of scale to maximise the return on such investments (Siew *et al*. 2020). To properly implement modern technology, a company's personnel must have the necessary knowledge and skills (Wang *et al*. 2019). Studies by Kgabo and Sithole (2019); Maphalala, Mwamakamba and Nkhwashu (2020) all found that the skills of employees were a key factor in the successful adoption of Industry 4.0 technologies in South African accounting firms. This indicates that employees who lack digital skills may struggle to use the modern technologies effectively, which can hinder the firm's ability to fully adopt and benefit from Industry 4.0. Firms that invest in employees training and development programs will be able

to fully adopt and benefit from Industry 4.0 technologies (Maphalala, Mwamakamba and Nkhwashu 2020).

Industry 4.0 is evolving at a rapid pace, making its adoption and implementation crucial to businesses' survival and competitiveness (Maisiri and Van Dyk 2019). KPMG (2018) conclude that as more businesses embrace digital technologies, they are also seeking accounting services that are delivered digitally, such as cloud-based accounting and real-time reporting. Vučinić (2020) suggested that competitive pressure is changing the needs and expectations of clients. There has been a growing demand for real-time data analysis, personalised services, and faster turnaround times from accounting firms (Kgabo and Sithole 2019). To meet these expectations and remain competitive, many firms in South Africa are turning to Industry 4.0 technologies to automate and optimise their processes (Deloitte 2020). Jajja *et al*. (2019) explain that businesses tend to copy successful competitors' creativity particularly those related to technology adoption and implementation. This helps to cushion the pressure emanating from the competitors and other trading partners.

Bryant and Higgins (2021) think that hesitation about implementing modern technology is associated with the perception of complexity. According to Rodrguez *et al*. (2020), complex innovations have a lower acceptance rate since they require more skilled labour and time to implement. As accounting firms adopt modern technologies such as artificial intelligence, machine learning, and automation, there may be a need to reorganise and streamline certain processes to take full advantage of these technologies (AlBar and Hoque 2019). This can be a complex and time-consuming task and may require significant resources and expertise. Adopting complicated technology will require staff to be trained on the use of that technology which is an extra cost to the firm.

Any modern technology must be easily implemented with no disruption to the current system. Kumar, Engle and Tucker (2018) revealed that businesses would be more inclined to adopt new and innovative technology if they are compatible with their current work practices. Software compatibility is one of the key factors that determines use intention (Hubert *et al*. 2018). When an accounting firm embraces Industry 4.0, it is essential to ensure that new technology is compatible

with older technology. If a firm's current processes and procedures are not compatible with Industry 4.0 technologies, it may be difficult or costly to make the necessary changes (Moeuf *et al*. 2018).

2.9.2 Cybersecurity risks associated with Industry 4.0 implementation in accounting

One of the frequently raised issue on the negative impacts of Industry 4.0 on accounting is cybersecurity risks. Gwebu, Wang, and Wang (2018) indicate that reputable investors are likely to downplay or reject the data breach occurrence, believing that the highly recognised company will quickly recover. Cybersecurity systems protect the physical world which is connected to 4.0 systems via the internet. The repercussions of a cyberattack on these networks might be disastrous (Kahyaoglu and Caliyurt 2018). For example, a cyber-physical attack on a German steel factory caused the blast furnace's essential parameters to become uncontrollable resulting in significant damage that ultimately resulted in the deaths of two employees (Padmanabhan and Zhang 2018). Amir *et al*. (2018) found a correlation between covert cyberattacks and a 3.6 percent decline in the stock price in the month of discovery.

Accounting firms have experienced cyberattacks in recent years, for instance, Wolters Kluwer, a major provider of tax and accounting services, suffered a ransomware attack in 2019 that led to a multi-day outage of its cloud services. The attack impacted many accounting professionals who rely on Wolters Kluwer's services, causing significant disruption during a critical tax filing period. The incident highlighted the vulnerability of cloud-based accounting services to cyber-attacks and the potential for business disruption (Maurer 2019). In addition, Deloitte, one of the "Big Four" accounting firms, experienced a sophisticated cyber-attack in 2017 that compromised confidential data, including the private emails of some of its clients. The attack went unnoticed for months and affected all sectors of the company, including its auditing, tax consultancy, and government advisory branches. The breach demonstrated the potential for significant reputational damage and loss of client trust following a cyber-attack (Wakefield 2017). Additionally, while not an accounting firm, the cyber-attack on the Panamanian law firm Mossack Fonseca in 2016 had significant implications for the accounting industry. The breach resulted in the leak of 11.5 million

documents detailing financial and attorney-client information. The incident highlighted the potential for cyber-attacks to expose sensitive client information and the need for robust cybersecurity measures in the accounting industry (Harding 2016).

Cybersecurity breach may collapse the entire critical industry infrastructure, jeopardising a country's economy (Kahyaoglu and Caliyurt 2018). Kahyaoglu and Caliyurt (2018) indicate that maintaining the integrity, confidentiality and resilience of contemporary businesses adopting Industry 4.0 technologies is a challenging task. Cybersecurity ensures the confidentiality of personal data, guarantees that authorised users have timely access to information and safeguards the authenticity, validity, and reliability of data (Haapamäki and Sihvonen 2019). Computer systems have become more vulnerable due to extensive interconnection. Cybersecurity has evolved into auditing and management accounting issue, requiring cost estimation, assessment of internal control, and disclosure requirement of management control system (Berkman *et al*. 2018).

Waslo *et al*. (2017) put that cyber risk management strategies must be safe, resilient, and completely integrated into a company's broader information and technological architecture in order to meet Industry 4.0 requirements. From the onset of an Industry 4.0-driven initiative, cybersecurity must be embedded into organisational operations, strategy and design. According to Waslo *et al*. (2017) analysis, businesses and their distribution networks may be exposed as a result of the integrated architecture of Industry 4.0 processes and the speed of digital transformation, and a data breach may have much more severe and widespread repercussions. However, when an organisation has robust internal controls in place, its information and data systems are better safeguarded.

Pendley (2018) posits that there should be more proactive thinking by accountants about security threats in their firms, and they should be able to adapt this knowledge into initiatives that will deter cybercriminals. According to Gordon *et al*. (2018), the design and implementation of management control mechanisms can help address cybersecurity concerns. The level of vulnerability influences how much resources are spent on information security by an organisation. In

most cases, the amount a company spends to secure data sets should be a small proportion of the projected loss. However, when a security breach involves non-sensitive information, there is no repercussion (Campbell *et al*. 2003; Shakya 2019).

According to Gordon *et al*. (2018), a firm's ability to safeguard the credibility of its internal and external financial disclosures and to maintain its strategic private information requires sufficient cybersecurity. The cyberthreat landscape is continually shifting, making it difficult to predict the possible impact of these cyberattacks (Agrafiotis *et al*. 2018). Additionally, Anderson *et al*. (2019) point out that measuring the impact of a data breach is challenging given the rapid pace of technological advances and the substantial asymmetry between predicting cost and revenue and their actual values.

Due to the interdependence of security threats, a single negative cybersecurity occurrence at one company might have a cascading effect, affecting other systems connected to the same computer system (Nelson and Simek 2019). Cybersecurity breaches have repercussions that extend beyond the immediate area of attack or vulnerability (Kashmiri, Nicol and Hsu 2017). Martin, Borah and Palmatier (2017) reveal that the impact of the security breach on peer firms is dependent on the degree of the attack. Cybersecurity that is effective lowers the danger of cyber-attacks and defends society, businesses, and humans from the unlawful use of systems, networks, and technology (Gyun No and Vasarhelyi 2017).

As a result, cybersecurity refers to the safeguarding of data that is analysed and communicated across a computer network. Cyber threats are centred around exploiting weaknesses in systems. Computer viruses also take advantage of weaknesses in code that enable an intruder to take control of a compromised system (Kesan and Hayes 2017). Firms are taking steps to tackle escalating cybersecurity threats because of the pressure from numerous stakeholders (Berkman *et al*. 2018). Among these measures are the appointment of executives with IT experience, the formation of IT committees at board level, the purchase or development of modern systems with increased security, as well as the purchase of insurance (Berkman *et al*. 2018). Regrettably, the financial

consequences of data breaches are currently uncertain, rendering the risk impossible to insure (Greenberg 2017).

The risk of losing custody of firm information has grown to be a concern that impacts the whole organisation (Ladley 2019). Moreover, hacking and phishing threats persist regardless of whether firms implement standards and measures to reduce the risk of data breaches. In addition, Ladley (2019) posits that data privacy and security are critical to a company's long-term viability and success. Businesses are using a variety of security measures, including system authentication, firewalls, user access management, and data encryption, as well as procedures aimed at reducing risks, such as training of staff and user orientation to the business's data security policies and protocols (Martin *et al*. 2017). The risk is increasing despite these precautions because criminals are getting more coordinated and sophisticated (Brody, Chang and Schoenberg 2018). Errors and negligence by employees are frequently the cause of security breaches and cyberattacks (Da Veiga 2018). In addition, Da Veiga (2018) suggests that a firm's culture on information security should be transformed into an acceptable level.

Businesses and consumers across the world are often unaware of malware's potentially detrimental impacts (Brody *et al*. 2018). Moreover, Martin *et al*. (2017) indicate that malware has the ability to take control of computers, smartphones, and e-commerce systems at the moment. Malware could be programmed as ransomware in an aggressive form, encrypting files and keeping them locked up unless a fee or ransom is received. Rathore *et al*. (2017) suggest that malware has the potential to cause destruction and even death if it is utilised maliciously. Van Alstin (2017) maintains that the adoption of a proactive instead of a reactive strategy by the cybersecurity unit is among the greatest strategies for responding to such vulnerabilities or concerns. A cybersecurity team that takes a proactive approach foresee future weaknesses and intrusions and put in place protections or steps to prevent them (Brody *et al*. 2018).

2.9.2.1 Implications of cybersecurity breaches on accounting firms

There are challenges associated with cybersecurity breaches on accounting firms. Cheng, Liu and Yao (2017) are of the view that the loss of confidential data

can result in substantial reputational and financial costs, as well as jeopardise an organisation's long-term stability. A company's reputation is a valuable intangible asset that can give it a competitive advantage (Confente *et al*. 2019). Fines, litigation fees, and sales loss from brand damage that can continue for months or even years after the event are also potential monetary losses linked with cybersecurity breaches (Waslo *et al*. 2017).

Ebrahimi and Eshghi (2022) observe that cybersecurity breach notifications are connected with lower stock market returns for the impacted organisations. Ebrahimi and Eshghi (2022) suggest that the form of the security incident, the time it occurred, where it occurred, and the size of the affected organisations all have an impact on this link.

Bachura *et al*. (2022) state that data breaches can have an adverse emotional and behavioural impact, including feelings of betrayal, grief, contempt, and distrust. Therefore, when a data breach happens, the price of the firm's stock is likely to fall since investors will interpret it as evidence that the corporation is no longer functioning with due care (Confente *et al*. 2019). Due to the potential lawsuit costs and negative publicity, the data breach may result in extra negative investor reaction and revenue loss for the hacked organisation (Kim, Johnson and Sun-Young 2017). According to Gwebu, Wang and Wang (2018) investors from reputable firms are likely to minimise or reject the data breach occurrence and believe that the highly valued company would quickly recover from it.

When a corporation announces a breach internally, rather than through an independent third party, investors will be less motivated to purchase shares of the company (Xu *et al*. 2019). A firm's ability to draw investors can be improved by the publication of an external security assurance report (Frank, Grenier and Pyzoha 2019). Cheng and Walton (2019) suggest that when a business has not reported a previous breach, it is more beneficial to release a management letter without a guarantee. Cheng and Walton (2019) submit that investor trust can be restored with the use of external security reports when it is accompanied with assurance. Even if a company has never had a security breach, reporting its cybersecurity practices to an external body can only help boost investor trust (Xu *et al*. 2019).

Corbet and Gurdgiev (2019) allude that the only time the stock price reacts negatively to data breaches is when investors have some evidence of the breach. Tosun (2021) suggests that data security breach can have disastrous knock-on effects on a firm's reputation, leading to the loss of goodwill and unusual client turnover which can affect their cash flows and earnings. A data breach can also cause a loss of competitive advantage over industry rivals due to a decrease in resources devoted to research and development and investments (Pereira, Barreto and Amaral 2017). In addition, Makridis and Dean (2018) indicate that organisations' policies and procedures are likely to change in response to the reputational implications of a data security breach. There is a dearth of information on the monetary cost of data security breaches (Tosun 2021).

Businesses that encounter a cybersecurity breach run the risk of sustaining severe revenue losses in addition to reputational harm (Johnson, Kang and Lawson 2017). The indirect repercussions (such as litigation, broken trust with customers and partners) will have a detrimental impact on future revenues and sales when combined with immediate losses like loss of revenue due to the inability to trade (Wang, D'Cruze and Wood 2019). Furthermore, Wang, D'Cruze and Wood (2019) point out that future reimbursements from lawsuits and other obligations may end up costing even more than the aforesaid estimates.

Firms are sometimes hesitant to report security breaches out of concern that the repercussions of a cybersecurity breach may expose confidential and sensitive data that could be detrimental to their operations (Corbet and Gurdgiev 2019). Tosun (2021) posit that the stock market reacts negatively to news of data breaches in the two trading days after the revelation. Jeong, Lee and Lim (2019) reveal that the disclosure of a security incident results in a decrease of approximately one percent of the company's market price in the days immediately following the occurrence of the breach. Jeong , Lee and Lim (2019) explain that a leak of secret information can have a devastating effect on a company's stock price, as opposed to a situation in which no such information is disclosed.

Janakiraman, Lim and Rishika (2018) show that businesses affected by data breach experience considerable drops in their earnings. Therefore, due to the

high consequences of a data security breach, both short-term and long-term, businesses are motivated to distort earnings in order to divert attention from the incident and ultimately increase stock prices (Kamiya *et al*. 2021). To prevent unfavourable outcomes of data breaches managers may be motivated to manipulate profits higher through real activities management (He, Frost and Pinsker 2020). The impact of a cybersecurity breach on earnings management is greater for companies with less analyst coverage, indicating that analysts act as external observers for businesses that experience data security breaches (He, Frost and Pinsker 2020).

Berkman *et al*. (2018) allude that cybersecurity incidents tend to be unfavourable occurrences for the affected businesses. Consequently, it is possible that businesses that have been devastated by cybersecurity data breach tend to make drastic adjustments in order to regain consumer trust (Haislip *et al*. 2017). Accruals management is a technique that managers can use to manipulate profits upward in order to prevent unfavourable outcomes like earnings declines (Elleuch Hamza and Kortas 2019). Elleuch Hamza and Kortas (2019) indicate that it is possible that companies that experience data breach will be significantly less motivated to participate in activities management to protect themselves from the possibility of additional drops in stock price.

In many instances, firms' that experience data breaches also suffer from system clean-up costs, liability costs (such as client litigation), fines, and brand and trust harm besides the reduction in market value (O'Leary 2019). The massive losses brought on by data breach diminish the financial flexibility and earnings quality of businesses (Corbet and Gurdgiev 2019). The high costs of cybersecurity data breach encourage managers to adopt policies that will generate revenue and earnings to reduce negative financial effects and preserve the firm's credibility (Berkman *et al.* 2018). There may be an increase in earnings management behaviour as a result of the decreased financial freedom and earnings quality (O'Leary 2019).

Even though market response varies depending on how serious cybersecurity data breach instances are, corporations typically see stock prices fall after cybersecurity data breach disclosure (Janakiraman *et al*. 2018). Additionally,

Brown (2016) believes that in order to maintain cyber-resilience, businesses must be ready for the likelihood of a data breach. A breach response that is properly managed can reduce response costs and help to prevent reputational damage (Brown 2016).

Zaharopoulos and Kwok (2017) point out that firm leadership may be motivated to adopt image control strategies since data breach disclosure can be viewed as a bad occurrence with potential legal, economic, and reputational repercussions. Company executives might seek to obscure negative news related to high-severity data breach occurrences by modifying the syntactical elements of the data breach notice messages in a manner that makes the content challenging for readers to understand (Jackson, Vanteeva and Fearon 2019). Business leaders who find themselves in a crisis might act in ways that serve their own interests (Jackson, Vanteeva and Fearon 2019). This could be the case because executives generally carry out their fiduciary obligations by receiving compensation that is directly proportional to the profitability of the company (O'Leary 2019).

Schatz and Bashroush (2017) opine that it is challenging to determine the precise effect that data security breach incidents have on the financial health of organisations. In addition to the loss of sales and reputation damage, the firms may also incur indirection costs related to the time spent by the employees to recover from the data breach. But it is not simple to identify the indirect costs of data breaches (Johnson *et al*. 2017). Anderson *et al*. (2013); Furnell *et al*. (2020) classified the costs associated with data security breaches into four groups as below.

(i) direct losses: damages, losses, or distress suffered by a victim of cybercrime

- The total amount of money taken from victim accounts as criminal revenue.

- income for the spammer who sends fraudulent emails (ransom payment).

- Resetting account credentials requires time and effort.

- additional fees for overdrawn accounts.

- Spam emails result in decreased bandwidth.

(ii) Indirect losses: damages and missed opportunities caused by cyberattack.

- decrease in trust for digital purchases.

- lost chance for online communication between firms and customers.

- efforts employed to remove malware from affected computers.

(iii) Defence expenses: the expense of preventative measures.

- Protection systems (backup systems, antivirus).

- cybersecurity training sessions for staff and customers.

- Measures taken to find and recover from data breaches.

(iv) Cost to society. Which includes both direct losses, defence expenses and indirect losses.

In addition, cyberattacks on businesses might result in decreased revenue collection by the government and the growth of the black market, which makes it difficult for the government to generate enough revenue for service delivery. The best and cheapest way to increase cyber security for businesses and individuals is to raise awareness among the employees (Kashmiri, Nicol and Hsu 2017).

2.9.2.2 Implications of cybersecurity breaches on management

Although the financial costs of cyberattacks are unquestionably significant, cybersecurity legislation has mostly ignored the psychological costs of data breaches (Ogbanufe, Kim and Jones 2021). In recent years, the emotional and mental consequences of data breaches on employees and customers have received increased attention. However, employees may experience stress even if the stolen information is never used for criminal activities. Doxing, cyberbullying, medical impersonation, publication of confidential data, manipulation, and targeted advertising are examples of such abuse (Ogbanufe, Kim and Jones 2021). There is no existing legal framework that addresses the psychological damage that victims of data breaches suffer because of this type of abuse. Even when there was proof of data misuse after hackers employed malware to take it, the courts have failed to declare that cyber-attacks cause any harm to the victims (Solove and Citron 2018).

While commenting on cybersecurity, Aboujaoude (2019) points out that people whose personal data has been compromised can experience anxiety, depression, and post-traumatic stress disorder because of the exposure. Kilovaty (2021) also put that psychological data breach trauma can also occur when a cybersecurity incident affects the availability of a vital service that customers need. Psychological trauma, fear, and insecurity can result from the inability to control an event that is viewed as dangerous (Bada and Nurse 2020). When people are worried about a significant cyberattack and understand that taking action could successfully counter that attack, individuals are encouraged to mitigate that threat (Nurse 2018).

The psychological consequences of cyber-attacks may even be comparable to traditional terrorism depending on who the attackers and victims are (Gross, Canetti and Vashdi 2016). The emotional trauma experienced by criminals and victims of cyber-attacks might cause depression. Moreover, people who fall victims to cyber-attack may experience anger, worry, and a lack of interest in embracing new technology because of their diminished trust in the internet. People's actions may change because of the fear of being a victim of crime (Bada and Nurse 2020). In addition, individuals who have fallen victim to cybercrime may take precautions to ensure they never fall victim again (Bada and Nurse 2020).

A study by Adams (2020) showed that 76 percent of workers reported that a data breach had adversely affected their personal relationships, and 16 percent of workers indicated that they had left the organisation due to stress related to data breaches. The study by Kaspersky (2020) found that 33 percent of managers who had to deal with a cybersecurity incident cancelled their personal event, 32 percent were required to work through the night, and 27 percent had to postpone their vacations. The report further revealed that 33 percent of the participants were subjected to extra stress. Dealing with cybersecurity Incidents might also force managers to postpone deadlines and other duties (Kaspersky 2020). Cyberattacks can make working at an affected company unpleasant.

Solove and Citron (2018) indicate that victims of a data breach may be hesitant to apply for a home loan because of the likelihood that lenders may learn that

their credit records have been linked to fraudulent activities. Victims of cybercrime may be reluctant to find employment for fear of their prospective employer finding out that they were involved in fraud (Solove and Citron 2018). managers may face social and personal consequences because of a cybersecurity breach. For example, if their personal information is compromised, they may face issues with credit agencies or lenders, and may have difficulty obtaining loans or other financial services.

Cybersecurity breaches can have serious implications for management and employees in terms of their personal and professional lives. For example, in 2017, the credit reporting company Equifax experienced a cybersecurity breach that exposed the personal information of millions of customers. As a result of the breach, several top executives at the company resigned, and the company faced numerous lawsuits and regulatory investigations (Forbes 2018). Another example is the Yahoo data breaches, which occurred in 2013 and 2014 and affected all 3 billion user accounts. The company's stock price fell, and the CEO and several other executives were replaced due to the breaches (Theguardian 2017).

Schaefer *et al*. (2017) elaborate that cybersecurity breaches can damage employee morale, leading to increased turnover and reduced productivity. If an employee is found to have contributed to a breach, either through negligence or malicious intent, their employment may be terminated or face other disciplinary action. A study by Tessian (2020) found that 25 percent of employees who made cybersecurity errors were dismissed. Additionally, an organisation may be forced to lay off employees to cut costs when they suffer financial losses from a data breach. A survey by Kaspersky (2018) showed that one-third of data breaches resulted in job losses, with senior non-IT professionals being laid off.

Companies and their management may face legal liabilities if they do not notify customers in a timely manner of a breach (Helberger and Reyna 2017). Management may incur additional costs as they seek to address any legal issues resulting from the breach. Cybersecurity breaches can result in financial losses due to forensic investigations and business interruption (Franke 2017). These financial consequences can negatively impact management, who may be held

responsible for the financial losses resulting from the breach. Torre, Dumay and Rea (2018) note that if a company's intellectual property is compromised, it can have negative consequences for management, who may be responsible for maintaining the company's competitive position.

2.9.2.3 How accountants can prevent and respond to a cybersecurity breach

The first step of protection against cybersecurity breaches should be the implementation of technical measures such as passwords, firewalls, and antiviruses. The easiest approach to secure computer networks is to avert intrusion (Allen 2017). Successful risk management requires the prioritisation and identification of risk. Risk management and identification are critical components in guarding against cyberattacks. A company's ability to detect potential security data breaches and take action before they happen is crucial, given the economic and reputational damage that can result from a security breach (Eaton, Grenier and Layman 2019).

Passwords are a common method of authentication and are often the first line of defence against cyber threats (Luo *et al*. 2018). Strong and unique passwords can help prevent unauthorised access to sensitive information (Luo *et al*. 2018). A strong password is difficult to guess or crack. Guo and Zhang (2018) note that strong and unique passwords include a combination of upper and lowercase letters, numbers, and special characters. Bošnjak and Brumen (2019) submit that a unique password is not used for any other account or system. A long password is considered to be stronger than a short one. According to the National Institute of Standards and Technology (NIST), a password should be at least 12 characters long to provide sufficient security (NIST 2017).

Reusing passwords across multiple accounts increases the risk of a security breach, as a single compromised password can grant access to multiple systems (Bošnjak and Brumen 2019). Using a password manager can help to ensure that passwords are strong and unique (Fagan *et al*. 2017). Guo and Zhang (2018) submit that password managers generate and store passwords and automatically enter them into login forms, so users don't need to remember them.

They also usually provide the option of storing two-factor authentication codes to make the account more secure (Fagan *et al*. 2017).

Regularly updating passwords helps to ensure that even if a password is compromised, access to sensitive information will be limited (Alshahrani and Alghamdi 2022). Many organisations have policies in place that require users to change their passwords on a regular basis. Aurigemma, Mattson and Leonard (2019) submit that employees should avoid using easily guessed personal information as passwords, such as a pet's name or a birthdate.

Nygard *et al*. (2021) assert that passwords are gradually becoming outdated and as a result factors of knowledge can easily be abused and stolen. However, the authors suggested that in order to reduce password vulnerability, several strategies such as recurrent password changes, reinforcing phrases, and combining multiple letter sets are used. Card keys and tokens have become more popular as possession factors since they provide better security than regular passwords (Nygard *et al*. 2021). Biometrics provide strong protection against intruders, yet many devices lack webcams or fingerprint scanners. Multi-factor Authentication (MFA) serves a critical role in enhancing account security and mitigating these concerns. Many applications, websites, and gadgets employ MFA to verify a user's identity across various devices and accounts (Nygard *et al*. 2021).

(i) Backup

Businesses ought to be able to retrieve lost information in the event of a data breach by having a recovery strategy in place (Manjezi and Botha 2018). Backup storage provides secure storage for a firm's everyday data, ensuring that company operations may continue as usual in the event of a cyber-attack. However, backed-up data should be stored offline since ransomware has the ability to corrupt data backup software (Erridge 2016; Zarifis *et al*. 2022). This suggest that regular backup of data is necessary to ensure that business can restore the most recent information, but backed-up data ought not to be linked to the internet (Allen 2017). Time-stamped copies of computer files must be created on a frequent basis by users, and these files must be periodically backed up.

(ii) Penetration testing

Penetration testing is a technique of locating an ethical entry point into a target network with the intention of auditing and repairing its security infrastructure. Penetration testing protects the company from financial loss while maintaining its reputation. It detects and mitigates potential security vulnerabilities even before they occur. Penetration testing also gives executives an idea of where they may need to make security-related purchases.

The function of ethical hackers and penetration testers is likely to grow in importance and is already considered a critical component of any company's cybersecurity strategy. Penetration testing is used to identify weaknesses in the firm's computer network in order to safeguard against criminals exploiting these flaws (Thomas *et al*. 2018).

These techniques can offer a more comprehensive picture of a firm's security measures, as well as extensive testing of computer security procedures, protocols, and controls (Thomas *et al*. 2018). Therefore, penetration testing helps organisations in preventing cyber-attacks. However, Thomas, Duessel and Meier (2017) caution that involving ethical hackers comes with certain risks. For example, the dangers of employing a hacker who might have turned into a criminal (Thomas *et al*. 2017).

(iii) Cyber-security training

Human mistakes handle about ninety percent of cybersecurity breaches, and the less staff know about cybersecurity threats, the greater the risk they present (Kemper 2019). The behaviour of employees continues to be a source of worry for many businesses due to the high frequency of cybersecurity breaches caused by employee behaviour (Wiley, McCormac and Calic 2020). Cyber-attacks can be prevented and mitigated by implementing cyber security education initiatives in the workplace. Zwilling *et al*. (2022) proposed that cyber security understanding be increased through training sessions that include simulators that shows individuals how to protect their computers. Literature reveal that the success of most cyber-attacks is attributed to users' lack of training and weakness (Chowdhury and Gkioulos 2021).

Al-Daeef, Basir and Saudi (2017) state that raising awareness on data security and developing training programmes for personnel and various stakeholders to

teach them how to secure their data and systems to minimise data breach. Security awareness training and education must be designed in such a way that they can influence individuals' level of understanding and behaviour (Zwilling *et al*. 2022). Cybersecurity awareness campaigns may be ineffective when they are not tailored to influence people's behaviour (Sabillon, Serra-Ruiz and Cavaller 2019). The establishment of "cybersecurity awareness" can help to mitigate the dangers posed by cyber threats and regulatory requirements, potentially increasing the value of a company (Berkman *et al*. 2018).

Fraudsters typically exploit victims' psychological vulnerability to create a sense of fear and urgency (Al-Daeef, Basir and Saudi 2017). They usually attempt to persuade victims to verify their profiles as soon as possible before they are blocked or cancelled. Therefore, individuals' who are unaware of cybersecurity risks are less concerned with the authenticity of emails and hence are more susceptible to deception than informed users (Aldawood and Skinner 2019).

Cybersecurity policy

An organisation's cybersecurity policy can play a critical role in preventing cybersecurity breaches in accounting by establishing clear guidelines and procedures for protecting sensitive information. According to Camillo (2017), a strong cybersecurity policy should include several key elements to mitigate risk effectively. The organisation's cybersecurity policy sets a clear definition of what constitutes sensitive information and how it should be protected (Talesh 2018). Sensitive information can be financial data, client information, and other confidential information that is specific to the organisation's accounting operations. The cybersecurity policy should establish strict access controls for sensitive information (Camillo 2017). Strict access controls can be the use of strong authentication methods, such as multi-factor authentication to ensure that only authorised individuals have access to sensitive information (Talesh 2018).

Shinde and Kulkarni (2021) conclude that an organisation's cybersecurity policy has guidelines for incident response and recovery in the event of a cybersecurity breach. For instance, procedures for identifying and containing breaches, as well as protocols for restoring systems and data to normal operations. The cybersecurity policy should require regular employee training and awareness

about the risks of cyber-attack and best practices for protecting sensitive information (Srinivas, Das and Kumar 2019). Regular employee training on the latest security risks, including phishing scams and social engineering tactics can help employees become more aware of the dangers of cyber threats (Srinivas, Das and Kumar 2019). The organisation must ensure that the cybersecurity policy is regularly reviewed and updated to stay current with the latest threats and best practices for preventing cyber-attacks (Camillo 2017). Regular review and updates ensure that the organisation is taking the necessary steps to protect sensitive information, as well as providing a mechanism for quickly adapting to new and emerging threats (Shinde and Kulkarni 2021).

Eaton, Grenier and Layman (2019) conclude that regular security assessments and audits helps prevent cybersecurity breaches in accounting. The assessments and audits can help identify vulnerabilities in the organisation's systems and networks and provide a mechanism for ensuring that security controls are functioning as intended (Eaton, Grenier and Layman 2019). In addition to the technical controls, an organisation's cybersecurity policy should include guidelines for detecting and responding to security incidents (Kahyaoglu and Caliyurt 2018). This might include having incident response plans in place and providing training to employees on how to identify and respond to potential security threats (Kahyaoglu and Caliyurt 2018). For example, conducting cyber-attack simulations and computer failure in a safe setting to prepare employees in case of a real cyber-attack. Calderon and Gao (2021) state that an organisation's cybersecurity policy ought to have guidelines for communicating with customers, employees, and other stakeholders in the event of a security incident. Wang and Johnson (2018) point out that communication guidelines can help mitigate the reputational damage that may result from a data security breach.

Data encryption

Encryption is a powerful tool for preventing cybersecurity breaches in accounting because it helps protect sensitive financial data from unauthorised access both in storage and in transit. When data is encrypted, it is transformed into a format that is unreadable to anyone without the appropriate decryption key

(Belmeguenai *et al*. 2017). Encryption makes it more difficult for hackers to steal or corrupt the data, even if they are able to gain access to the network or system where it is stored (Eaton, Grenier and Layman 2019). Transport encryption helps to protect the data from being intercepted and read by unauthorised parties as it moves from one system to another (Vithanwattana *et al*. 2017). For example, when a user accesses their online banking account, the connection between their computer and the bank's servers is usually encrypted to protect the sensitive financial information that is exchanged.

Vithanwattana *et al*. (2017) submit that businesses can use storage encryption to protect the data from being accessed or modified by unauthorised parties even if they are able to gain physical access to the storage device. Financial statements saved in the cloud could be encrypted on the server so that no one can access the data without the proper key. Zhu *et al*. (2020) explain that encryption technology being used in various software solutions like enterprise resource planning (ERP) systems, accounting software and e-payment gateway add a layer of protection to the data. Encryption can be used to prevent cybersecurity breaches in accounting by using it in combination with secure key management (Strang, Che and Vajjhala 2020). Encryption keys are the codes that are used to encrypt and decrypt data (Zhu *et al*. 2020). An accounting firm can use firewalls, intrusion detection systems, and regular security updates to protect their networks and systems, and then use encryption to protect the sensitive financial data that is stored on those systems. This approach is known as defence-in-depth, and it helps to ensure that even if one security control is breached, the data will still be protected by other layers of security (Mosteiro-Sanchez *et al*. 2020).

Antivirus

Antivirus software can prevent cybersecurity breaches in accounting by detecting and blocking malicious software. These malicious software’s known as malware, viruses, worms, trojans, and ransomware are used to gain unauthorised access to a system. Baillon *et al*. (2019) indicate that antivirus software uses a variety of techniques to detect malware, including signature-based detection, which looks for known patterns of code associated with specific types of malware, and

heuristic-based detection, which looks for suspicious behaviour that may indicate the presence of malware. Antivirus software prevents breaches by monitoring network traffic for suspicious activity and alerting network administrators to potential threats (Baillon *et al*. 2019). However, antivirus software alone is not enough to protect against all cybersecurity threats, and it should be used in conjunction with other security measures such as firewalls, intrusion detection and prevention systems, and regular software updates and patching (Angst *et al*. 2017).

Ștefănescu *et al*. (2019) posit that antivirus software can prevent cybersecurity breaches in accounting by providing real-time protection. This means that the software is constantly running and monitoring the system for any suspicious activity. When an attempt to install malware is detected, the antivirus software will block the malware and notify the user (Ștefănescu *et al*. 2019). Real-time protection helps to ensure that the system is always protected against the latest threats (Kearns 2016). Ozkaya and Aslaner (2019) admit that antivirus software that includes endpoint security provides protection for all the devices on the network, not just the ones that are installed with the software. This helps to ensure that all devices are protected, which is important in an accounting environment where employees may be working remotely or using their own devices to access sensitive data.

2.9.2.4 Responses to cyber breaching by accountants

When a data breach is reported, a firm may employ a range of mitigation strategies to actively reduce the damage. The best recovery techniques and their respective efficacy in minimising the negative effects of a data breach are still poorly understood (Asthana, Kalelkar and Raman 2021). A thorough investigation is frequently necessary to ascertain what caused the breach and lessen the possibility that it will occur again (Woods and Bohme 2021). Businesses that adhere to the idea of image preservation usually choose approaches that fall between defensive and accommodating (Kim, Johnson and Sun-Young 2017).

According to Hartmann and Carmenate (2021), accommodating approaches like apology and restorative endeavours elicit both positive and negative reactions.

Overly accommodating tactics could incur financial and legal consequences. The authors contend that a public admission of culpability for the data breach is required by an apology, which could prompt legal action and damage the company's legal defence.

Bansal (2021) shows that denial and acknowledgement of wrongdoing are effective techniques for restoring trust following a data breach, particularly when the incident can be traced back to forces outside of the organisation. Furthermore, Muzatko and Bansal (2018) indicate that rapid acknowledgement of a data breach is preferable to a delayed response. Furthermore, suppressing information about the cybersecurity event may convey the message that management is unconcerned about its customers (Muzatko and Bansal 2018).

Ngo-Ye, Nazareth and Choi (2017) claim that defensive methods are appropriate when an organisation has concrete evidence to support its contention that there has been no data breach or when it is totally unresponsible for the incident. Defensive approaches emphasise the business's rejection of any cybersecurity event or responsibility for any security violation. When investors take a defensive approach, it is far easier for them to alleviate cognitive dissonance by rejecting and discarding any noncredible argument. Adopting a defensive posture without a clear rationale, on the other hand, may lead to mistrust and allegations of dishonesty, undermining any response initiatives (Ngo-Ye, Nazareth and Choi 2017).

According to a study conducted by Fuoli, van de Weijer, and Paradis (2017), denial was more effective than an apology in restoring public trust in the firm's integrity. Extremely hospitable actions may send the incorrect message that the company considers the breach is severe, causing investors to view the data breach unfavourably (Gwebu, Wang and Wang 2018). It is expected that the apology from the violated corporation will increase the impact of compensation and that the firm's restitution will increase the impact of the apology in restoring trust (Cui *et al*. 2018).

Cyber insurance is a type of insurance policy that provides coverage for losses resulting from cyber-attacks and data breaches (Vakilinia and Sengupta 2018). In the accounting industry, cyber insurance can be used as a response to

cybersecurity breaches in several ways. Cyber insurance can provide financial protection for businesses against the costs associated with responding to a cybersecurity breach (Kshetri 2020). These costs can include legal fees, public relations expenses, and the cost of hiring a forensic investigator to determine the extent of the damage (Kshetri 2020). Additionally, cyber insurance policies often include coverage for data recovery and business interruption, which can help businesses quickly resume operations after a breach (Vakilinia and Sengupta 2018).

Cyber insurance can provide liability coverage in the event that a business is sued as a result of a cybersecurity breach (Hare-Brown 2019). For example, if a breach results in the loss of personal data belonging to customers, the business could be held liable for damages. Khalili, Naghizadeh and Liu (2018) state that cyber insurance helps cover the costs of legal defence and any settlements or judgments that may result from such a lawsuit. Hare-Brown (2019) submitted that cyber insurance can be used to manage risk of cybersecurity breach. By purchasing a cyber insurance policy, businesses can transfer some of the risk associated with a cybersecurity breach to the insurance company (Kshetri 2018). Purchasing a cyber insurance policy allows businesses to focus on implementing effective cybersecurity measures, rather than worrying about the potential financial consequences of a breach (Kshetri 2018).

Cyber insurance policies provide access to a wide range of incident response services (Woods and Simpson 2017). These services can include assistance with data recovery, crisis management, and public relations (Woods and Simpson 2017). Cyber insurance policies include access to incident response teams made up of cybersecurity experts who can help businesses respond to a breach in a timely and effective manner (Xie, Lee and Eling 2020). These teams can assist with identifying and containing the breach, restoring lost data, and communicating with customers and other stakeholders. Xie, Lee and Eling (2020) elaborate that many cyber insurance policies require policyholders to take certain steps to protect their systems and data before a breach occurs. The conditions in the insurance policy may require the organisation to implement certain cybersecurity measures, such as firewalls, intrusion detection systems, and employee training programs (Talesh 2018). These requirements are in place

to help minimise the risk of a breach occurring in the first place and can be helpful for businesses in the accounting industry that handle sensitive financial information (Talesh 2018).

Document backup is an essential part of any organisation's cybersecurity strategy, particularly for accounting departments that handle sensitive financial information (Bradshaw, Brazil and Chodorow 2019). By regularly creating and maintaining backups of important documents, organisations can ensure that they are able to recover quickly in the event of a cybersecurity breach (Bradshaw, Brazil and Chodorow 2019). Document backup can prevent cybersecurity breaches in accounting by providing safety in the event that sensitive financial data is lost or stolen (Achar 2018). For example, if an attacker gains access to an accounting department's network and encrypts or deletes important financial documents, a recent and valid backup of those documents can be used to restore the data and minimise the impact of the attack (Achar 2018). A copy of the important document can be saved in cloud services, like AWS S3, Microsoft Azure and Google Drive.

Demirkan, Demirkan and McKee (2020) submit that document backup can prevent cybersecurity breaches in accounting by providing a means of detecting and responding to an attack more quickly. If a backup copy of financial documents is kept in a separate, secure location, it can be used to compare against the current version of the documents to determine if any changes have been made (Demirkan, Demirkan and McKee 2020). This can help to quickly identify a potential attack and take appropriate action to stop it (Bradshaw, Brazil and Chodorow 2019). Additionally, Achar (2018) concludes that in the event of a ransomware attack, a recent and valid backup can be the only means to restore the document and not pay the ransom, as the attackers would have encrypted the current document and made it unreadable.

Implementing regular access and change audits on backups is important, especially with the increasing prevalence of internal threats, this could detect any unauthorised access or modifications of backups (Okereafor and Adebola 2020). As a best practice, the backup solutions should be updated with the latest security patches, software updates and encryption standards (DeVoe and

Rahman 2016). Businesses must ensure that the backup solutions are configured properly and securely. This means setting up strong authentication and access controls, limiting network access to only authorised systems and users and disabling any unnecessary features or services (DeVoe and Rahman 2016).

Brown (2016) states that implementing versioning of backups allows businesses to keep multiple versions of the backup document. Versions of backups will allow businesses to restore the document at different points in time, and not just the last version in case of disaster recovery (Wallace and Webber 2017). Businesses can use multiple layers of security and encryption, like hardware security modules (HSM) and end-to-end encryption to protect data (Wallace and Webber 2017). Raghavan, Desai and Rajkumar (2017) concur that hardware security modules protect backups from malicious actors who may attempt to access or decrypt the backup data. DeVoe and Rahman (2016) elaborate that regular testing and monitoring of backups is crucial in ensuring that they are functioning properly, and that data can be recovered in case of an incident. This includes performing regular backup tests and restores, as well as monitoring for errors and issues that may indicate a problem with the backup process. Regular, secure and compliant backups are essential for accounting departments to protect against cybersecurity breaches (Desai and Rajkumar 2017).

Cyber risk strategy is a critical component of an organisation's cybersecurity efforts, as it allows organisations to proactively identify and address potential vulnerabilities before they can be exploited (Shinde and Kulkarni 2021). A cyber risk strategy for accounting organisations should include a comprehensive incident response plan (IRP). The IRP should outline specific procedures for responding to different types of incidents, such as data breaches, denial of service attacks, and ransomware attacks (Shinde and Kulkarni 2021). The incident response plan should outline a clear chain of command for incident response, and roles and responsibilities for different team members (Sturm *et al*. 2017).

Hopkin (2018) submits that organisations should conduct regular risk assessments to identify potential threats and vulnerabilities, and then prioritise

those risks based on their likelihood and potential impact. Understanding the system's weaknesses and vulnerabilities is necessary before one can take action to stop a cyberattack (Sturm *et al*. 2017). This can be achieved by simulating an entire lifecycle of a cyberattack, from its inception to its hypothetical execution. The risk assessment process should include input from all relevant stakeholders, including IT, finance, and accounting personnel (Nifakos *et al*. 2021). To prevent and detect cyber threats, organisations must implement security technologies such as intrusion detection and prevention systems (IDPS), security information and event management (SIEM) systems, and advanced threat intelligence services (Hopkin 2018). These technologies can help detect and analyse suspicious network activity and alert security teams to potential threats (Nifakos *et al*. 2021).

Kim, Choi and Han (2020) explain that incident management is an important aspect of cyber risk strategy of an organisation. Incident management involves incident detection, incident response, and incident recovery (Kim, Choi and Han 2020). Incident detection is the process of identifying a security incident and understanding its scope and impact (Ahmad *et al*. 2021). Incident response is the process of taking immediate action to minimise the damage of an incident and prevent it from spreading while incident recovery is the process of restoring normal operations after an incident and returning the organisation to a normal state (Ahmad *et al*. 2021). Moreover, incident management should be followed by incident reporting and incident documentation, which is an important part of compliance and regulatory requirements (Kim, Choi and Han 2020). Organisations must maintain an incident management system which will record all incidents, their causes, their impacts, and the actions taken to mitigate them (Baillon *et al*. 2019). This system can be used to analyse incidents and identify patterns, as well as to provide evidence of compliance with regulations and standards.

2.10 Conclusion

This study examines the impact of Industry 4.0 on accounting business. It is clear from the preceding discussion that Industry 4.0 has got both positive and negative impact on accounting business and profession. Simply put, the literature

above has explored how the emergence of Industry 4.0 has been influencing accounting practices in terms of preparing financial statements, compiling reports, communication with stakeholders, real-time information gathering, continuous auditing, document storage, financial forecasting, risk analysis, preparing of accounts and tax returns. In addition, the literature has explored the opportunities presented by Industry 4.0 in accounting (for example, labour cost, data processing, productivity, risk assessment, data storage, communication channels). Challenges presented by Industry 4.0 on accounting in terms of acquisition, regulations, privacy and security, employee's competencies, and legacy system have also been explored.

Furthermore, the literature has explored the role of management in implementing Industry 4.0 in your firm (motivating employees, creating a vision for change, communicating change, planning for change, creating a conducive environment for change, getting employees' buy-in and leading staff by example).

Most importantly, the literature has explored the cybersecurity risks associated with Industry 4.0 implementation in accounting (cyber-attack, hacking, malware, phishing). Thus, implications of cybersecurity breaches on accounting firms (loss of revenue, reputational damage, operational disruption, and regulatory sanction, loss of confidential information, litigation costs, cost of replacing damaged equipment) have been critically discussed. As such, aspects such as implications of cybersecurity breaches on management/leadership (for example, Increased stress, anxiety, lowered productivity, conflict among employees, loss of income, and disciplinary action) have been reviewed in the literature.

Finally, the literature reviewed revealed how accountants prepare for, respond to, and recover from cybersecurity breach (for example, file backup, firewalls, system updates, encryption, antivirus, educating employees, login authentication, password, risk strategy, internal controls, cyber-security testing, Purchase cyber insurance, Cyber-security investments). In order to understand the impacts of the Industry 4.0 on accounting, the study adopted the TOE and Institutional theories.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter gives a summary of the methodology that was used to answer the study questions. The information collected was used to investigate relevant aspects that addressed the research questions. The research paradigm that underpins this analysis is explained in this chapter. The research design and methods used, including the study's target population, sampling process and size, data collection, data analysis, and the methodology taken to achieve ethics, validity and reliability are discussed in this chapter.

3.2 Research design

Sekaran and Bougie (2016:95) define research design as “a blueprint or plan for the collection, measurement, and analysis of data, created to answer your research questions”. Kumar (2018) describes research design as an overview of the path a researcher may choose to take during their research journey to obtain reasonable, objective, precise, and cost-effective answers to research questions. Research design is defined by Creswell and Creswell (2018:53) as "types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research study". Choy (2014) asserts that qualitative research enables the participants to bring up more issues due to the use of open-ended questions.

Yilmaz (2013) suggests that through participant observation and interviewing, the researcher can interpret meanings, process, and contextualise the subject under study by employing an inductive approach in qualitative research. The qualitative research approach was adopted because the possible answer to the research question requires an explanation from the participants rather than a simple Yes or No. Qualitative research is suited since it aids in a better understanding of the topic being investigated and thus how accounting is influenced by Industry 4.0 in South Africa. In addition, a qualitative research approach is relevant due to its flexibility in eliciting more answers from participants through further probing because of the open-ended questions

deployed by the researcher. The researcher employed a data collection method consistent with the qualitative research design.

In a qualitative research approach, theories such as (TOE and Institution theory) are used to guide the data collection and analysis process. The theories help to shape the research questions, determine what data to collect, and provide a framework for interpreting the data. In this study, the TOE and Institution theories guided the exploration of how technological, organisational, environmental, and institutional factors influence the adoption of Industry 4.0 in the accounting sector.

The research objectives of this study are to explore various aspects of the adoption of Industry 4.0 in the accounting sector, including the opportunities and challenges it presents, its influence on accounting practices, the role of management in its implementation, the factors influencing its adoption, and the cybersecurity risks associated with it. These objectives align well with a qualitative research approach, which is typically exploratory in nature and seeks to understand phenomena in depth. Qualitative research methods, such as interviews (telephone interviews) were used to gather rich, detailed data on these topics. The study's theoretical framework and research objectives align well with qualitative research. The theories provide a guiding framework for understanding and interpreting the phenomena being studied, while the research objectives align with the exploratory and in-depth nature of qualitative research.

3.3 Ontology

Ontology aims to give a comprehensive and conclusive classification of objects in all aspects of being (Smith 2003). Ontological assertions involve the nature of reality (Cohen, Manion and Marrison 2018). When qualitative researchers undertake research, they embrace the concept of multiple realities (Creswell and Poth 2016). In a qualitative study, researchers, participants, and readers all embrace different realities (Cohen, Manion and Marrison 2018). Qualitative researchers undertake research on individuals with the goal of reporting on different realities. Creswell and Poth (2016) explain that evidence in themes from participants' actual words provide a different perspective of multiple realities. The ontological assumption herein is that there is no single reality

considering that the study adopts an interpretivist research paradigm to help understand and interpret participants' lived experiences on the impact of Industry 4.0.

The ontological position of this study aligns with the constructivist view, which posits that reality is socially constructed and subjective. In other words, there are multiple realities that exist based on individuals' perceptions and interpretations. This view is particularly relevant to the study as it seeks to understand the diverse experiences and perceptions of accounting professionals in KwaZulu-Natal, South Africa, regarding the influence of Industry 4.0 on their practices. The constructivist view acknowledges that each participant may have a unique perspective on this phenomenon, shaped by their experiences, context, and interpretations (Creswell and Poth 2018).

3.4 Epistemology

According to the epistemological assumption, doing a qualitative study involves researchers attempting to get as closer to the participants (Bahari 2010). Therefore, subjective evidence is gathered based on the participant's views. Ritchie *et al*. (2013) indicated that epistemology assumption is concerned with knowledge and the study of what is regarded as acceptable knowledge in a specific profession. Consequently, epistemological assumption is the way we understand, know about and explore the realities. Ritchie *et al*. (2013) pointed out that epistemology assumption explores the nature of knowledge and what forms acceptable knowledge in a particular field. Bahari (2010) further explains that epistemological assumptions might be thought of as a question of what constitutes acceptable knowledge in a certain field. Therefore, epistemological assumptions are related to the nature of knowledge and the techniques through which that knowledge might be obtained (Saunders, Lewis and Thornhill 2016).

The epistemological position of this study aligns with the interpretivist approach, which asserts that knowledge is gained through seeking to understand the world from the perspective of the individuals living in it. This approach emphasises the importance of subjective experiences and interpretations in the construction of knowledge. In the context of this study, this means that the researcher seeks to understand the influence of Industry 4.0 on accounting practices from the

perspective of the accounting professionals themselves, through their own words and experiences. The researcher will interpret these experiences to construct a meaningful understanding of the phenomenon. The approach acknowledges that the researcher's own interpretations and understanding are part of the knowledge construction process (Creswell and Poth 2018).

The ontological and epistemological positions of this study reflect a commitment to understanding the subjective realities and experiences of accounting professionals in KwaZulu-Natal, South Africa, as they navigate the influence of Industry 4.0 on their practices. This approach acknowledges the complexity and diversity of these experiences and seeks to interpret them in a meaningful and nuanced way.

3.5 Research paradigms

Research paradigm is a philosophical lens through which research study is conceptualised and done (Leavy 2017). Hitchcock and Hughes (1995) suggested that research is based on assumptions. This shows that different scholars may hold different assumptions regarding the nature of truth and knowledge, as well as how they are acquired (Cohen, Manion and Morrison 2002). That is why it is critical to know the benefits and drawbacks of each technique. This enables the researcher to better prepare for the investigation as well as a good understanding of the research phenomenon. Positivism, pragmatism, critical realism, and interpretivism are four different paradigms and will be discussed in this study.

3.5.1 Interpretivism research paradigm

According to interpretivism, humans are distinct from physical phenomena in that they construct meaning (Saunders, Lewis and Thornhill 2019). This indicates that interpretivist researchers need to use different ways to investigate the physical phenomena of humans and their social surroundings. Interpretivist research aims to develop new, more holistic understandings and analyses of social realities and contexts (Saunders, Lewis and Thornhill 2019). For example, looking at how Industry 4.0 is influencing accounting practices from the view of different individual accountants. Mills, Bonner and Francis (2006) suggest that researchers need to adopt a research philosophy consistent with their views about the nature of reality to ensure a solid study design. This study adopts

interpretivist research philosophy which aided the researcher to examine the influence of Industry 4.0 on the work of accountants.

Crabtree and Miller (2022) emphasise the suitability of interpretivism philosophy to the study of humans and their social context. Interpretivism is useful for researchers who want to learn about participants' perceptions, feelings, and experiences (Yilmaz 2013). The researcher's goal in this study is to gain a better understanding of the issues at hand by listening to participants describe their personal experiences on how accounting is influenced by 4.0Thanh and Thanh (2015) state that the interpretivism philosophy is relevant for researchers who want to determine a participant's knowledge, perspective, and experience rather than relying on statistical data. The use of the interpretivism paradigm in this study aids the researcher in comprehending the participants' experiences and perceptions, as well as gaining insight into the research issue.

Thanh and Thanh (2015) explain that interpretivist researchers adopt a flexible strategy to gather information about their participants' experiences, which allows them to obtain rich and in-depth data. Interpretivist researchers are more naturalistic because they relate to real-life circumstances that occur naturally without coercion (Antwi and Hamza 2015). Burke (2007) indicates that interpretive paradigm posits that information and meaning are interpretive actions, and that scientific knowledge is inextricably linked to human thinking and reasoning. According to Burke (2007), interpretivists look at the evidence gathered about occurrences and interpret it by making conclusions from the data and a theoretical pattern. The interpretivist researchers are concerned with understanding the world as seen through the views of one's own personal experience. Creswell and Creswell (2018) alluded that the interpretivism paradigm employs meanings associated with methodologies such as interviewing or observing participants which is dependent on the researcher and participant's relationship.

According to Neuman (2013), interpretivism focuses on the complete complexity of how humans make sense of events as they happen rather than predefined variables. According to Farzanfar (2005), interpretivist investigations are

interpretive in nature, with the goal of understanding a specific occurrence rather than generalising to a population.

3.6 Research strategy

The research strategy section is an essential component of any research project as it outlines the approach, methods and techniques that are used to gather and analyse data. It is essentially a roadmap that guides the researcher through the entire research process and helps to ensure that the results are reliable and valid. A research strategy provides a foundation for the successful completion of a research project by outlining the steps and methods that will be used to achieve the research objectives. Different research strategies are discussed below.

3.6.1 Phenomenological research

This study employed a phenomenological research strategy. Phenomenological approaches are particularly effective at bringing to light human perceptions and experiences from their own points of view, and thereby challenging normative or structural assumptions (Bogdan and Biklen 1997). In addition, phenomenological techniques aim to comprehend what events mean to ordinary individuals in specific settings (Bogdan and Biklen 1997). individuals' interpretations of their experiences and the process by which they do so are vital, not incidental or ancillary to the event itself (Aspers 2009). Events from people's pasts, writings, families, television, personalities, job, and play are all interpreted differently by people (Langridge and Ahern 2003). Therefore, an individual develops meaning through the interaction with these combined factors (Langridge and Ahern 2003).

The views of the actors are crucial in the analysis (Garza 2007). One of phenomenological research's greatest assets is its ability to adapt to ever-widening arcs of inquiry (Garza 2007). phenomenological research strategy is not ideal for making broad generalisations about such structures (Langridge and Ahern 2003). Nonetheless, phenomenological techniques are effective at bringing up difficult subjects and allowing voices to be heard (Moustakas 1994). A study adopting a phenomenological research strategy generates a significant number of interview notes, tape recordings, jottings, and other records, all of which must be analysed (Aspers 2009).

The outcome of phenomenological research is a general description of the phenomenon as seen through the eyes of those who have first-hand experience with it (Leedy and Ormrod 2005). A phenomenological study attempts to understand public views, perspectives, and understanding of a specific situation (De Vos *et al*. 2005). This approach maintains that all humans are constantly interpreting, creating, giving meaning, defining, justifying, and rationalising their daily actions (Babbie and mouton 2001).

3.6.1.1 Descriptive phenomenology

Descriptive phenomenological research was inspired by Husserl's (1970) philosophical concepts about how scientific studies should be performed (Cohen 1987). Husserl argued that subjective knowledge should be crucial for scientists working to explain human behaviour since what individuals consider to be real influences what they do (Matua and Van Der Wal 2015). A person's view of their lifeworld is shaped by the deep and complicated source of hidden meaning linked with being and experiencing (Christensen, Welch and Barr 2017).

Descriptive phenomenology is based on the concept that the researcher must forget all previously acquired knowledge in order to understand the core life experiences of the subjects being researched. This requires the researcher to intentionally cleanse his or her mind of all prior expert knowledge and personal preconceptions (Natanson 1973). Some academics argue that researchers adopting the descriptive phenomenology approach should not review literature before commencing with the research and should not have particular research questions apart from the intention of capturing the individuals' lived experiences in respect to the study's issue (Streubert and Carpenter 1999). Bracketing has been recommended to researchers adopting descriptive phenomenology approach as a technique to help them set aside their previous experiences (Cohen and Omery 1994). Bracketing enables researchers employing descriptive phenomenology to suspend their preconceived opinions and individual knowledge while listening to and commenting on participants' real experiences (Drew 1999).

Bracketing is the technique of detecting and suspending preconceived thoughts and attitudes regarding the subject being investigated (Smith and Shinebourne

2012). Although complete bracketing is impossible, researchers seek to isolate the data from the rest of the world and any preconceptions in order to examine it in its purest form (Dowling 2007). Bracketing is an iterative procedure that involves planning, reviewing, and giving regular feedback on the success of the bracketing (Smith and Shinebourne 2012).

Cohen (1995) suggests that instead of conducting the study yourself, researchers can have someone else perform an audiotaped interview with them first. This allows researchers to gain insight into their own perspectives on the issue before any information is gathered and analysed (Cohen *et al*. 2000). This suggest that if a researcher does not think about what they already know, they can come up with a novel way to analyse the collected information (Smith and Shinebourne 2012). Finlay (2009) maintains that it is hard to completely forget what you know and how you feel because you cannot block everything out in real life.

3.6.1.2 Interpretive phenomenology as a preferred research strategy

Lopez and Willis (2004) indicate that the foundation of interpretive phenomenology is the interpretation of participant narratives in connection to various situations. Lopez and Willis (2004) claim that the philosophical belief that underpins the interpretive phenomenological technique is that the researcher's expert knowledge are useful guide to inquiry. Koch (1995) stresses that it is difficult to remove from someone’s mind the background of ideas that prompted the researcher to first consider a problem worthy of inquiry. Therefore, researchers are able to use their knowledge from the literature to determine whether more research is needed in an understudied issue (Wojnar and Swanson 2007). It is the researcher's understanding of the subject area that leads to particular ideas about how the investigation should be carried out in order to generate relevant knowledge (Wojnar and Swanson 2007). Thus, personal knowledge is both valuable and required for researchers adopting interpretive phenomenological strategy (Geanellos 2000). LeVasseur (2003) indicates that the practice of bracketing is problematic and inconsistent with interpretive phenomenology.

In interpretive phenomenology, the researcher's meanings are a synthesis of the meanings expressed by both participants and researchers within the scope of the study (Smith 2011). Therefore, interpretative phenomenology approach was adopted for this research study because the researcher sought to interpret and comprehend participants' opinions in order to ascertain their meaning. When two people connect in an effort to comprehend and learn about one another, their interactions are founded on a shared set of past experiences and the meaning they attach to them (Emery and Anderman 2020). This implies that the process of interpretation is constrained by the differing and overlapping views of the researcher and the participant (Geanellos 2000). As a result, the narratives might be interpreted in a variety of ways depending on the research phenomenon (Lopez and Willis 2004).

Any interpretative study cannot provide a single genuine meaning; rather, the meanings revealed in the research findings must be coherent and credible within the research context, and they must represent the experiences of the participants (Annells 1996). Study participants must be carefully selected to be persons who have all encountered the event in question (Willis *et al.* 2016). In this study accountants are purposively selected because of their experience with technology and ability to provide relevant information to answer the research questions.

Smith *et al*. (2009) explain that “Interpretive phenomenological analysis involves a double hermeneutic as it integrates not only the participant’s sense of their lived experience but also the researchers’ attempt in understanding how the participant makes sense of their personal and social world”. The goal is to pose pertinent questions in order to establish the meaning of being (Willis *et al.* 2016). The interpretive aspect allows researchers to look for patterns in experiences across the collected data, relate those experiences to a broader literature, and eventually add to what is known about the phenomena (Allan and Eatough 2016). To study people's lived experiences, it is essential that researchers and participants must understand each other's interpretations because it is impossible to directly access a person's lifeworld (Patton 2019). Interpretive phenomenology is an approach that is both inductive and iterative (Engward and Goldspink 2020).

Interpretive phenomenology entails a series of lengthy, in-depth interviews with people who have personally encountered the issue of interest (Bramley and Eatough 2005). This is relevant to the study because the researcher employs in-depth telephone interviews as a data collection tool. Interviews were tape-recorded and transcribed verbatim before the interpretation and analysis. Researchers adopting interpretive phenomenology approach should interpret each interview text with an open mind in that they must be willing to hear what the text is saying (Polit and Beck 2008). Interpretation is a process that is constantly changing and evolving (Conroy 2003). Meanings are co-created by the individual and the world. Humans build relationships with others and therefore we do not develop our meanings as separate individuals without regard for others (Allan and Eatough 2016). Our perceptions and interpretations of the world are mutually formed and symbiotic (Conroy 2003).

A researcher is "considered inseparable from assumptions and preconceptions about the phenomena under investigation," according to interpretive phenomenology (Tuohy *et al.* 2013). These must be acknowledged and incorporated into the conclusions of the study (McCance and Mcilfatrick 2008). According to Flood (2010), researchers are unable to disassociate themselves from what they know and believe. This information can be a useful guide to investigation, and Flood (2010) proposes the concept of “co-constitutionality”, which states that meanings are a combination of participants' and researchers' meanings. However, it is critical for researchers to recognise and disclose their biases so that readers of their research work understand the context of the study and potential influencing elements (Tuohy *et al*. 2013).

The study adopts Interpretive phenomenology which focuses on understanding the lived experiences of individuals and how they interpret those experiences. It's particularly useful when the goal is to understand complex phenomena from the perspective of those experiencing them. The TOE and Institution theories provide a lens to understand the adoption of Industry 4.0 in the accounting sector. Interpretive phenomenology aligns with these theories as it seeks to understand the lived experiences of individuals within these technological, organisational, environmental, and institutional contexts. It allows for an in-depth exploration of how these factors are perceived and interpreted by individuals in the accounting

sector and how these interpretations influence their decisions and actions related to the adoption of Industry 4.0.

The research objectives of the study involve understanding the opportunities and challenges presented by Industry 4.0, its influence on accounting, the role of management in its implementation, the factors influencing its adoption, and the cybersecurity risks associated with it. Interpretive phenomenology addresses these objectives by exploring the lived experiences of individuals in relation to these aspects. For example, interpretive phenomenology can provide insights into how accountants perceive and interpret the opportunities and challenges presented by Industry 4.0, how they experience its influence on their work, how they perceive the role of management in its implementation, what factors they perceive as influencing its adoption, and how they perceive and manage the cybersecurity risks associated with it. Interpretive phenomenology, with its focus on understanding lived experiences and interpretations, does provide a rich and better understanding of the adoption of Industry 4.0 in the accounting sector, addressing both the theoretical framework and the research objectives of this study.

3.7 Data collection

This section discusses data collection methods used by qualitative researchers. Data collection, according to Creswell (2014), is the process of acquiring information from people using observation, documents, interviews, visual and audio material. The researcher's data collection strategy was in-depth interviews. Semi-structured interviews are more appropriate and were employed by the researcher since they are open-ended and permit for further questioning for additional information. Qualitative researchers use different data collection techniques and are discussed below.

3.7.1 Observation

Yin (2011) suggests that participant observation can be a beneficial technique of gathering facts because what researchers witness with their own eyes and feel with their own senses is not distorted by what other authors have reported or documented. Therefore, participation by researchers in the research study allows them to see, listen, and perceive life in the same way as the people being studied.

Rossman and Rallis (2016) indicate that participant observation necessitates first-hand interaction in the social environment under investigation, implying that the researcher has to play the role of an observer and a participant. In addition, the researcher should spend a significant amount of time in the location, studying about daily life of the participants (Rossman and Rallis 2016).

Participant observation is data collection approach with roots in qualitative sociology and cultural anthropology (Rossman and Rallis 2016). Cowie (2009) reveals that ethnography is closely associated with observation, but it is also used in action research, case studies, and mixed methods research to collect data to answer research questions. Seeing that ethnography is closely associated with participant observation, it is essential for the researcher to create a good relationship with the participants in the study environment in order to gather data. Leavy (2017) concurs that some participants may become key informants who may introduce a researcher to other potential participants during data collection.

The researchers adopting participant observation will remember the appearance, sounds, the scents, and even the weather of a study setting long after they have left. When a researcher collects data through participant observation, they take field notes on the activities and behaviour of people at the research location (Creswell and Creswell 2018). Field notes are data that are written or documented notes of researcher's observations in the field (Leavy 2017). Field notes should be organised in a systematic manner (Kumar 2011). The field notes may also include the date, time, and location of the study.

3.7.2 Focus group

Krueger and Casey (2014) mentioned that a focus group is a unique form of group in terms of makeup, goal, size, and procedures. A researcher selects participants because they possess particular characteristics related to the topic under study (Hoque *et al*. 2017). Opinions are gathered through focus groups from individuals that share similar experience about the issue under study. Focus groups are moderated group conversations in which a researcher asks questions to elicit responses from the participants (Kumar 2011). Focus group discussions normally translates to about six to eight people, though the exact number

depends on the study's objectives (Hennink and Leavy 2014). A large focus group may make it difficult for all members of the group to participate effectively (Cowton and Downs 2015). A large focus group can become difficult to moderate hindering participation from all the participants.

Gawlik (2018) suggests that a well-balanced and moderated focus group can provide a sense of security to its members, making it easier to start the discussion and open up during the interview. When individuals believe they are similar in some characteristics, they are likely to share their life experiences (Krueger and Casey 2014). For example, participant of the same sex, age, education or marital status can easily discuss their experiences in life. Focus group discussion should take place in a neutral and permissive setting where participants feel free to share their opinions or experiences without fear of being judged by others (Madriz 2003; Hennink, Hutter and Bailey 2011; Wong, Cooper and Dellaportas 2015). Open-ended questions commonly used in focus group discussions are intended to elicit responses, generate conversation, and prompt participants (Sutton and Arnold 2013).

Kamberelis and Dimitriadis (2013) indicate that the procedures and tools used to collect data in individual interviews cannot be effectively adapted to focus groups. Furthermore, Kamberelis and Dimitriadis (2013) are of the view that even if these procedures are adopted into focus groups discussions, they rarely take advantage of the unique and deep potentials for knowledge development that focus groups provide. Williamson (2013) explain sthat Individual interviews offer an opportunity for a researcher to provide clarification, ask follow-up questions, and observe the body language of participants. Kumar (2011) reveals that focus group discussion is a common strategy for data collection in almost every professional and academic discipline due to the low cost of organising it. Gammie, Hamilton and Gilchrist (2017) reveal that researchers in accounting discipline rarely employ focus groups as a data collection strategy.

3.7.3 Archival research

Archival inquiry is a non-experimental approach of data collection that entails examining database information (Bordens and Abbott 2018). Archival investigations use secondary data to understand a phenomenon under study,

particularly those that pertain to the past and how they have changed over time. Archived qualitative data can be reanalysed, updated, and compared to current data (Corti and Thompson 2004). Qualitative data that has been archived is a valuable and unique source of research material (Corti and Thompson 2004). Previously recorded information can be a valuable component of any society and serve as historical and modern research data. For example, court documents, research articles, social media information and any other documented material.

Reviewing archives can be used to track the progress of a theme under investigation over time, as it provides intriguing insights. However, researchers who want to repurpose material in this way must first assess the evidence, investigate its provenance, and assess the sources' reliability (Seale *et al*. 2003). Using secondary data can save money while also eliminating duplication of work because collecting new data is usually costly (Seale *et al*. 2003). Secondary data enables researchers to conduct longitudinal and comparative research due to the availability of data (Flick 2022). Any information generated now will be a future historical resource.

Researchers collect data to answer a specific problem under study. Therefore, secondary data sources do not always imply suitability. Even though archived information is the interpretation of earlier primary data. The quality of a content analysis is only as good as the documents on which it is performed (Bryman and Bell 2011). Creswell and Patton (2018) assert that permission and, in some situations, travel to libraries to view paper-based documents are required to access biographical documents and archives.

3.7.4 Interviews as data collection tool adopted by this study

The research interview is a structured conversation involving two or more individuals in which the interviewer must build rapport, pose succinct and explicit questions to which the interviewee is prepared to listen carefully and answer (Marshall and Rossman 2014). Interviews are about asking relevant questions and paying attention to the responses so that interviewer may dig further into the issue under investigation. Therefore, interviews can aid in the collection of valid and trustworthy data relevant to answer the research questions (Marshall and Rossman 2014). Miller and Glassner (2016) indicate that “qualitative interviews

provide us access to social worlds, as evidence both of ‘what happens’ within them and of how individuals make sense of themselves, their experiences and their place within these social worlds”.

Schostack (2006) explains that “the interview is not a simple tool with which to mine information. It is as much about seeing a world”. This indicates that qualitative interviews help researchers to understand the lived experiences of individuals under study. Therefore, in-depth qualitative interviews can provide knowledge about social worlds (Silverman 2016). Participants create social world by sharing stories with researchers (Silverman 2016). The primary information collected from interviews show the authentic image of people’s experiences. During an interview, participants can speak openly about issues and concerns that are important to them. Miller and Glassner (2016) show that when two people express their experiences to one another, they can learn about each other's social environments.

Researchers use phenomenological interviews to get extensive accounts of participants' experiences with a phenomenon by asking open-ended questions about their feelings, views, and understandings (Roulston and Choi 2018). Additionally, Roulston and Choi (2018) suggest that researchers ask a series of questions to elicit open-ended discussions about study issues that are guided by what participants have to say. Individual in-depth interviews allow the researchers to probe extensively into social and personal issues, whereas group interviews allow researchers to gain a broader range of experience but hinder them from going as deeply into the individual (Johnson 2002). The goal of a qualitative research interview is to add to a conceptual and theoretical body of knowledge based on the significance that life experiences have for the participants (DiCicco-Bloom and Crabtree 2006).

The nature of the information that the researcher is looking for is specified in the interview designs. Qualitative research interviews are designed to elicit thorough descriptions of the specific event under investigation (deMarrias 2004). Therefore, the intention of the researcher during the interview should be to maintain the discussion focused on specific details of the phenomenon rather than generalised debates about it (deMarrias 2004). The researcher can achieve

this by asking follow-up questions based on the responses given by the participant. For example, “You mentioned about…could you elaborate more on….”

Researchers obtain qualitative data through interviews since it allows participants to “speak in their own voice and express their own thoughts and feelings” (Berg 2007: 96). Even though an interview is designed to resemble a discussion, it is considerably different from a normal interaction between two individuals (deMarrais and Lapan 2004). An interview, according to Schostak (2006), is an extended dialogue between partners aimed at gathering in-depth knowledge about a specific topic or issue, and through which a phenomenon can be analysed in terms of the meanings that participants bring to it. It is possible to collect such meanings in a variety of ways. For example, through face-to-face interviews, group interviews, telephone interviews, email interviews and internet mediated interviews. The interviews are always guided by the interview questions or interview schedule.

3.7.4.1 Types of interviews

There are three types of interviews: structured, semi-structured, and unstructured. Different types of interviews are discussed below.

(i) Structured interviews

Structured interviews make use of questionnaires that are based on a set of questions that has been predetermined or standardised (Denzin and Lincoln 2011). In addition, Qu and Dumay (2011) refer to structured interviews as “interviewer-completed questionnaires”. Structured interviews offer the researcher complete control over the participants thereby limiting their ability to be flexible and free (Stuckey 2013). Structured qualitative interviews are conducted in a structured manner similar to job interviews as all applicants are expected to answer in same fashion. During structured qualitative interview, the researcher's questions are brief, and the participants are supposed to answer in a similar manner, with brief and concise responses (Adhabi and Anozie 2017).

Structured interviews are the ones that are done with the assistance of an interview guide in which each participant is asked the same set of questions.

Corbin and Strauss (2015) elucidate that structured interviews are the least successful method of collecting data in grounded theory research because a structured interview eliminates the possibility of making changes during data gathering based on analysis of earlier interviews. In addition, participants lose a lot of influence over the interview process in standardised interviews. Participants in structured interviews typically answer solely to the questions asked by the researcher probably because they are hesitant to bring up new issues not in the interview questionnaire (Corbin and Strauss 2015). The researcher must follow a set of guidelines when conducting structured interviews (Stuckey 2013). Therefore, the standardised interview setting is likely to be tense because of the guidelines followed by the researcher which can make participants feel uneasy and lead to irrational replies (Adhabi and Anozie 2017).

The structured interview is most likely to involve telephone interviews, interviews in public settings, and interviews related with survey research (Stuckey 2013). In addition, Stuckey (2013) suggested that structured interview is useful when the researcher has a good understanding of the research problem and formulates open-ended questions that are designed like a survey questionnaire. Therefore, structured qualitative interviews are also known as "quantitative research interviews" since they are used to gather quantifiable data (Pathak, Jena and Kalra 2013). However, structured interviews are communicated orally instead of in writing (Zhang and Wildemuth 2009). The responses from participants are pre-coded in standardised schedule. In addition, Merriam and Tisdell (2015) indicated that structured interviews can be utilised in a descriptive study to detect broad patterns because the data is standardised, making statistical propositions or hypotheses easier to examine. Moreover, the structure of questions in structured interviews usually need straightforward answers, mostly of the yes or no (Alshenqeeti 2014).

(ii) Unstructured interviews

Zhang and Wildemuth (2009) indicate that the unstructured interview approach was established as a tool to elicit participants' social realities in different disciplines. According to Patton (2002), unstructured interviews are a natural evolution of participant observation since they often occur as part of continuing

participant observation research. Corbin and Strauss (2015) submit that participants have more control over the flow of the interview in unstructured qualitative interviews. Furthermore, researchers employing unstructured interviews can ask follow-up questions on aspects that were considered to be important and in need of more clarification with the same or a different participant (Corbin and Strauss 2015).

Zhang and Wildemuth (2009) point out that each unstructured interview may produce data with varying structures and patterns. The reason could be that the researcher goes to the interview with no predetermined assumptions or queries regarding the phenomenon being investigated however questions are not random or non-directive. Instead, the researcher interacts with the participants and formulates questions in response to their description of events (Zhang and Wildemuth 2009). A researcher needs a lot of preparation and knowledge about the study setting when conducting unstructured interviews (Patton 2002). If a researcher has relevant experience with the issue under investigation, they may be able to produce more probing questions (Chauhan 2019). Additionally, Corbin and Strauss (2015) indicate that unstructured interviews provide the most comprehensive data set for the development of theories.

Researchers can better show attributes like warmth, acceptance, and social responsiveness in an unstructured interview than they do in a structured interview (Dipboye 1997; Schmidt and Zimmerman 2004). Unstructured interviews allow the researcher to observe nonverbal communication from the participants. Any discomfort or distress that the respondent is experiencing can be noticed through unintentional frowns, anxious tapping, and other body language (Merriam and Tisdell 2015).

The purpose of the unstructured interview is for the researcher to bring certain preliminary issues to light so that he or she may determine which variables require further inquiry (Merriam and Grenier 2019). Unstructured interviews are those in which the format of the interview has no planned sequence of questions (Roulston and Choi 2018). Moreover, Corbin and Strauss (2015) opine that the use of an unstructured interview approach does not rule out the possibility of researchers having some control over the interview's outcome. In addition,

Roulston and Choi (2018) suggest that because the researcher may not have a pre-formatted interview guide leading to the interview, the interaction is more likely to resemble a casual conversation.

(iii) Semi-structured interviews

In this study semi structured interviews were adopted because they combine the components of unstructured and structured interview format (Conzelmann and Keye 2014). The most common interviewing format for qualitative research is semi-structured in-depth interviews, which can be conducted individually or in groups (Merriam and Grenier 2019). It is for this reason that qualitative researchers rely solely on semi-structured in-depth interviews for their data (DiCicco-Bloom and Crabtree 2006). Semi-structured interviews take the form of a conversation, allowing participants to explore issues that are relevant to them despite predefined questions prepared by the researcher (Longhurst 2003). With the flexibility of semi structured interviews participants may have something important to say that the researchers may have not included in the interview questions but relevant to the study. As suggested by Longhurst (2003) this study focuses on gaining a better knowledge of the research problem by encouraging participants to recount their experiences with the phenomena.

Semi-structured interviews are preferred by qualitative researchers because they allow them to ensure some uniformity in the themes presented in each session (Corbin and Strauss 2015). McIntosh and Morse (2015) claim that while participants in semi-structured interviews can take as much time as they like to answer open-ended questions, their responses are rarely in-depth. DiCicco-Bloom and Crabtree (2006) suggest that as researchers learns more about the setting, they collect data regarding the meaning of observed interactions, behaviours, rituals, and artefacts, with questions arising over time.

Instead of a yes or no response, semi-structured interviews permit participants to answer questions in an open-ended manner using their own words (Longhurst 2003). This view from Longhurst (2003) supports the choice of semi-structured interviews for this study since it gives participants more freedom to express themselves and allows certain answers to be probed in greater detail. However, semi-structured interviews have the same characteristics as unstructured

interviews in that they are interactive between the participant and the researcher and mirror a conversational exchange similar to that which occurs in real life (Jennings 2005).

According to Corbin and Strauss (2015) participants can add anything more to the interview that they think is pertinent to the conversation once the list of questions has been answered. Corbin and Strauss (2015) maintain that researchers can also ask follow-up questions to clarify points or go deeper into a research problem. Therefore, having conversations with others is a great approach to obtain knowledge. Persons must be chosen based on their prior familiarity with the research theme (Cameron 2005).

The building of rapport, reciprocity, and mutual respect are the cornerstones to successful interviews (Jennings 2005). People can only share their thoughts with the researcher if a trusting and harmonious relationship has been built, especially if the phenomenon under study is sensitive. Gaining trust, developing rapport, and gaining access to participants takes time (Zhang and Wildemuth 2009). This suggests that the interview period must include time to form a social relationship, as well as time to build trust and respect, because these aspects are also important in qualitative interviewing (Jennings 2005).

Horton, Macve and Struyven (2004) indicate that the need to obtain the perspectives of the most crucial individuals as well as the flexibility of semi structured interviews, surpasses the statistical analysis restrictions that would ensue. Therefore, the most essential aspect to success in employing semi structured interviews is flexibility, both in designing and improving research instruments and during the interviews (Horton, Macve and Struyven 2004). Longhurst (2003) opine that semi-structured interviews can be utilised for a wide variety of research because they are conversational in character and can be used in conjunction with a variety of different methodologies and theories.

A semi-structured interview strategy was utilised to encourage open and in-depth discussion of the research issue. By adopting semi-structured interviews as a form of data collection, the researchers attempted to obtain a deeper understanding of participant experiences through discussion. Interviews allow the researcher to seek clarification and gain a better knowledge of the situation.

Because the researcher is a tax professional at the time of the study, he may be able to share his own experiences with the participants, thereby matching them. Interviews aid the researcher in establishing trust and communication with the participants, as well as making it easier for them to disclose information.

3.7.4.2 Modes of conducting interviews

(i) Face to face interviews

According to Gray *et al*. (2007), personal contact makes an interview more significant, and it is unlikely for a participant to refuse an interviewer in person over a questionnaire that can be tossed away. In a face-to-face interview, Alasuutari, Bickman and Brannen (2009) suggest that having an interviewer present helps to inspire participants and shape the interview scenario. Face-to-face interviews, according to Alasuutari, Bickman and Brannen (2009), establish an environment conducive to verbal and nonverbal communication. Alasuutari, Bickman and Brannen (2009) note that in face-to-face interviews, participants can be asked to sort things or complete specific activities, or the interviewer can perform physical measures. Face-to-face interviews have the advantage of allowing participants to be exposed to audio-visual stimuli while the interviewer observes and records their responses (Shaughnessy, Zechmeister and Zechmeister 2000).

Interviews, according to Bernard (2018), have flaws due to the researcher's inherent bias and the lack of standard set questions. Interviewer bias, according to Shaughnessy, Zechmeister and Zechmeister (2000), can be eliminated by using a well-trained and experienced interviewer. According to Salkind (2014), the lack of anonymity in face-to-face interviews may make participants less likely to answer questions honestly than they would on a questionnaire. Face-to-face interviews are costly and time-consuming since they require a researcher to travel to the participants preferred location (Darlington and Scott 2020). Kumar (2011) claims that the interviewer's experience, willingness, and expertise may have an impact on the data quality provided during an interview. Kumar (2011) claims that the quality of data gathered from an interview can be influenced by the quality of interaction between the interviewer and the participant, as each interview is unique, and perspectives might differ dramatically.

(ii) Mail interviews

A study by Hershberger and Kavanaugh (2017) conclude that asynchronous, in-depth email interviews were effective, yielding rich and relevant information that supplements the telephone interviews. Similarly, Cook (2012) used in-depth email interviews on 26 women who had been diagnosed with sexually transmitted disease. Cook (2012) indicates that in-depth email interviews can yield a wealth of information and that the response rate was high. This could be associated with the partial anonymity offered by email interviews. In addition, the online conversation and email interview have the added benefit of allowing more people to participate (Saarijärvi and Bratt 2021). Online research approaches, according to Liamputtong (2007), make research more ‘user-friendly' for vulnerable groups by boosting their comfort and control.

Advancement in technological innovation has allowed qualitative researchers to conduct interviews using alternate data collection methods rather than traditional face to face, focus group or telephone techniques. Despite the improvements and increased access to technology Krouwel, Jolly and Greenfield (2019) maintain that certain groups may be omitted because they are uncomfortable with or lack access to the necessary technologies. Yet these excluded individuals could possess wealth of knowledge about the research problem. Moreover, Saarijärvi and Bratt (2021) suggest that with the increased diffusion of technology in the society, the convectional qualitative data gathering techniques may become obsolete.

(iii) In-depth telephone interviews

This study adopted telephone interview which enabled the researcher to collect rich and relevant information on how Industry 4.0 is affecting the work of accountants. Sturges and Hanrahan (2004) support the use of a telephone for qualitative data collection. Sturges and Hanrahan (2004) reason that telephone interviews can provide a wealth of information, which is vital for qualitative research. Telephonic interviews also give the researcher accessibility to participants who live in places where the researcher is not allowed, such as military facilities or geographical areas that are difficult to reach (Opdenakker 2006). Telephone interviews were considered appropriate for this study since

most accountants are working from home due to the outbreak of COVID-19 pandemic. Telephone interviews are safer for both the researcher and the participant because neither must travel to an interview location, and some individuals would prefer not to have their personal space invaded (Hanna 2012).

Some study settings are too risky to visit in person, therefore calling is a better alternative (Sturges and Hanrahan 2004). The current outbreak of COVID-19 makes the adoption of telephone interviews right for this study. COVID-19 regulations require individuals to maintain social distance and wear mask which can affect the recording of the interview. Researchers have had to quickly convert to alternate solutions such as telephone or video interviews due to social distancing, travel limitations, and other restrictions, which have had practical repercussions for the traditional face-to-face data gathering approach (Saarijärvi and Bratt 2021).

When contrasted to face-to-face interviews, telephone interviews help researchers to collect huge amounts of data in a short space of time (Wagner *et al*. 2012). In addition, telephone interviews, like face-to-face interviews, let researchers to ask participants follow up questions for more information. Semi-structured interviews are desirable and acceptable for qualitative research because they allow participants to respond to questions in a flexible manner, allowing for rich data collection (Jackson *et al*. 2007).

Changes in telephone communications, such as the increased usage of answer phones, various forms of call blocking, and mobile phones, have harmed telephone interviews in respect of response rates and the general difficulty of reaching participants via traditional landlines (Darlington and Scott 2020). However, the researcher addressed this by contacting participants early to arrange an appropriate time and date convenient to them to take part in the interview. Participation may necessitate some initial contact, whether in person, by phone, or even by mail, to request collaboration (Sturges and Hanrahan 2004). Besides participation in the specific research is not contingent on owning a phone.

Study by Darlington and Scott (2020) concluded that telephone interviews were an acceptable and valuable form of data collection technique. Therefore,

telephone interviews are successful in collecting in-depth information (Aquilino 1991). Additionally, Fowler (2009) indicated that telephone interviews generate more socially desirable responses than face-to-face interviews. However, the absence of important social factors in telephone interviews may jeopardise the interview's main conduct, and therefore its trustworthiness and validity (Cohen, Manion and Morrison 2018). Although telephone interviews lack intricacies of face-to-face interviews, Holt (2010) asserts that this loss lets the researcher to ‘stay at the level of text' and avoid putting contextual information on the data.

Researchers adopting face to face interviews claim that the researcher’s ability to create and sustain rapport during the interview is harmed by the lack of visual clues (Shuy 2003). Rapport is considered crucial in creating a welcoming environment that allows participants to talk openly and honestly. As a result, the participant provides rich and detailed information during the interview (Fontana and Frey 2005). Despite the researcher’s ability to observe the body language of participants during face-to-face interview, Novick (2008) claims that interpreting or attempting to understand body language is a difficult and time-consuming activity.

Furthermore, the lack of body signals encourages both the researcher and the participant to pay close attention during the interview (Trier-Bieniek 2012). Similarly, Qu and Dumay (2011) suggest that active listening skills can make the interview go more smoothly. Another requirement for a successful interview is the ability to articulate queries clearly (Hermanowicz 2002). Moreover, the lack of visual signals requires both the researcher and the participant to communicate their messages precisely (Stephens 2007). The quality of the communication process is improved through effective listening and clearly communicating a message, resulting in fewer misconceptions.

Fenig and Levav (1993) are of the view that participants who accept to participate in an interview about sensitive issues may prefer the partial anonymity of a phone interview. Therefore, telephone interviews may boost participants' sense of anonymity (Greenfield, Midanik and Rogers 2000). The sensitive nature of the issue under study may influence the outcome. It is therefore important that both the researcher and participant to be careful of their safety when dealing with

studies that are sensitive. In a similar view, Sturges and Hanrahan (2004) point out that researchers' safety concerns and dangerous settings serve to limit research study. In these instances, telephone interviews may help to save the research study if the target population can be contacted by phone (Sturges and Hanrahan 2004).

The TOE framework considers the technological context of an organisation. In the era of Industry 4.0, using telephone interviews aligns with the technological advancements and digital communication tools prevalent in a contemporary business environment. Similarly, the Institutional theory discusses normative pressures and the need to gain legitimacy. Conducting telephone interviews adheres to normative research practices and adds legitimacy to the research process. The interviews were recorded using a cell phone, and participants were asked to sign the consent form. Each interview lasted for approximately 30 minutes, and they were conducted over a period of two months.

3.8 Criteria for recruiting participants.

The researcher purposively chose accountants and invited them to participate. The participants must have worked as an accountant for not less than five years and in an executive position. These executives play a vital role in outlining a long-term strategy of a company. The belief was that these candidates have valid and valuable study data on how accounting practices are influenced by Industry 4.0. To take part in the study, the participants were directly contacted. Before conducting the interviews, a formal request for permission to conduct the study was made to the accounting firms and several ethical considerations were discussed, including informed consent, anonymity, and confidentiality, securing authorisation, and no damage and but rewards.

The selection of participants is limited to specific individuals who can furnish the needed information to help the researcher answer the research question (Darlington and Scott 2020). Additionally, Cooper and Schindler (2014) assert that "participants for individual depth interviews are usually chosen not because their opinions are representative of the dominant opinion but because their experiences and attitudes will reflect the full scope of the issue under study". The purposive sampling strategy employed in this study aims at ensuring that a

researcher identifies a group of people who can provide relevant data in a well-organised manner (Bryman and Bell 2011). The researcher purposively selects individuals in this case accountants based on their relevance to the topic under investigation. Purposive sampling is a strategy where participants are chosen because of their distinctive features, experiences, attitudes, or perspectives (Cooper and Schindler 2014).

3.9 Target population

The target population for this study is accounting professionals and firms in KwaZulu-Natal, South Africa. This includes accounting professionals who are directly involved in accounting practices and experiencing the effect of Industry 4.0 in their practices. The firms may range from small and medium-sized enterprises to large corporations. According to the South African Institute of Chartered Accountants (SAICA), there were more than 41 000 registered accounting firms in South Africa (SAICA 2020). In a qualitative study examining how accounting practices are being influenced by Industry 4.0 in KwaZulu Natal, the target population is a critical component that shapes the direction and outcomes of the research. The term "target population" refers to the specific group of individuals and objects that the research is designed to study (Sekaran and Bougie 2016). This group (accounting professionals) would be defined by their occupation, their experience with Industry 4.0 technologies, and their geographical location (Creswell and Poth 2017).

The importance of the target population in this qualitative research cannot be overstated. The experiences and perspectives of accounting professionals in KwaZulu Natal regarding the influence of Industry 4.0 on their practices directly shape the data collected and, consequently, the findings and conclusions of the study. The goal is not to generalise findings to all accounting professionals, but to gain a deep and better understanding of the specific population under study in KwaZulu Natal. The richness and depth of the data collected are directly tied to the experiences and perspectives of the target population (Patton 2015).

In contrast to quantitative research, which often involves large sample sizes to ensure statistical significance, the target population in this qualitative research is smaller (Patton 2015). This is because the focus of qualitative research was on

depth and detail rather than breadth and generalisability. The researcher seeks to delve deep into the experiences and perspectives of the target population, exploring the complexities of their lived experiences with Industry 4.0. This often requires spending a significant amount of time with each participant, conducting in-depth interviews, observations, or other forms of data collection that allow for a deep exploration of the participant's experiences (Merriam and Tisdell 2015).

The process of selecting the target population in this research study was purposive rather than random. This means that the researcher intentionally selects individuals whom he believes can provide rich, detailed, and insightful data about the influence of Industry 4.0 on accounting practices. This approach, known as purposive sampling, allows researchers to focus their efforts on individuals who are particularly knowledgeable about or experienced with the research topic (Palinkas *et al*. 2015). Purposive sampling leads to more meaningful and insightful findings than would be possible with a random sample (Palinkas *et al.* 2015).

The homogeneity of this population lies in their professional role and their engagement with accounting practices. Regardless of the size of the firm or the specific industry, these professionals are all tasked with maintaining financial records, conducting audits, providing financial advice, and ensuring compliance with financial regulations. Their work is guided by the same fundamental principles and standards of accounting, and they all face similar challenges and opportunities presented by the advent of Industry 4.0.

The geographic location of KwaZulu-Natal is significant for several reasons. KwaZulu-Natal is a third contributor to the Gross Domestic Product (GDP) and the most populous province in South Africa, it is home to a large number of businesses and, consequently, a substantial population of accounting professionals. The province's economy is diverse, with key sectors including manufacturing, agriculture, tourism, and services, providing a broad context for the study of accounting practices. Furthermore, KwaZulu-Natal has a mix of urban and rural areas, which may influence the adoption and impact of Industry 4.0 technologies in different ways. However, it's important to note that while this study focuses on KwaZulu-Natal, the findings may have broader implications for

understanding the impact of Industry 4.0 on accounting practices in other regions of South Africa and potentially beyond.

The target population of this study examining how accounting practices are being influenced by Industry 4.0 in KwaZulu Natal was not just a group of individuals who happen to fit certain criteria. Rather, they were carefully selected group of individuals whose experiences and perspectives was to provide deep and detailed insights into the research question. The selection of this population is central to the qualitative research process, shaping the direction of the study and the nature of its findings. The study was conducted in five accounting firms with 13 accounting executives.

3.10 Sampling

Sampling is the procedure of choosing the appropriate individuals, objects, or events to represent the total population (Sekaran and Bougie 2009). Luker (2008) suggests that using the term sampling in qualitative studies causes confusion as the phrase is closely connected with quantitative research. Qualitative researchers' sample in a different way and for a different reason from quantitative researchers. Sampling methods allow researchers to limit the volume of data they need to gather by selecting data from a subset rather than all potential cases or elements (Saunders, Lewis and Thornhill 2019).

3.10.1 Sampling strategy

Probability and non-probability sampling are the two most common sample strategies employed by researchers. Non-probability sampling encompasses a variety of strategies for selecting samples, most of which depend on researchers' subjective judgement (Darlington and Scott 2020). Snowball, quota, convenience, and purposive sampling are examples of non-probability sampling strategies utilised by qualitative researchers (Wilson 2010). The next section discusses different non-probability sampling strategies. This allows the researcher to select an appropriate strategy that will enable him to collect relevant data to answer the research questions.

(i) Snowball sampling strategy

Snowball sampling strategy is a non-random sampling approach that is employed by qualitative researchers when it is not easy to identify members of a specific group or population (Goodman 2011). Snowball sampling technique where existing study participants bring in new study participants who could be their friends, colleague, or neighbour to participate in the research study (Sharma 2017). Therefore, the researcher collects more data as the number of participants increases. This is because existing participants may know a person in their group with relevant information that is useful for the research study. In addition, the next participant may feel free to share their experiences with the researcher because he/she was referred to them by their acquaintances whom they trust.

Yates and Leggett (2016) indicate that the main challenge with snowball sampling techniques is the difficulty of the researcher in making initial contact with the first participant. Cohen, Manion and Morrison (2018) point out that it becomes difficult to collect a sample and acquire access to it when the topic under study is sensitive. Heckathorn (2002) is of the view that this strategy is beneficial for sampling a group where access is challenging, possibly because the research topic is sensitive (for example, target participants engage in illegal activities), or when participants are sceptical of researchers.

Researchers that use snowball sampling select a small number of people who have the characteristics they are looking for (Cohen, Manion and Morrison 2018). Snowball sampling is prone to bias because participants are more likely to identify other possible participants with similar characteristics to their own resulting in a homogeneous sample (Yates and Leggett 2016). For example, the sample could become entirely female or ethnically homogeneous. Furthermore, Sharma (2017) opines that it is difficult to establish the likely sampling error and make statistical inferences from the sample to the population because snowball sampling does not choose units for participation in the study based on random selection. Therefore, snowball samples ought not be taken to represent the community under investigation.

(ii) Quota sampling strategy

The goal of quota sampling is to create a sample that accurately reflects a group in terms of relative percentages of individuals in various groups (Yates and Leggett 2016). For example, individual sexuality, race, age groupings, socioeconomic groups, and home region, as well as combinations of these characteristics. Cooper and Schindler (2014) maintain that quota sampling can be used to increase representativeness in a qualitative study since the strategy is based on the idea that certain key features reflect the population's dimensions. Hammarberg, Kirkman and de Lacey (2016) explain that quota sampling is a type of proportionate stratified sampling technique where a predefined proportion of persons are randomly selected from various groups for the sake of convenience. Quota sampling is appealing for some research studies because of the convenience it provides in terms of time and resources (Hammarberg, Kirkman and de Lacey 2016). In a similar study Kumar (2016) found that quota sampling is the cheapest technique to choose a sample; researchers do not require any details about the sampling population, and it ensures the inclusion of the individuals that the researchers need.

Cooper and Schindler (2014) explain that quota sampling has a flaw in that the concept that quotas on some variables imply representativeness on others is an assumption by analogy because it provides no assurance that the sample is representative of the variables under investigation. Kumar (2016) suggests that because the most available individuals may have features that are unique to them, they may not be fully representative of the entire sampling population. The sample size requirements for quota sampling are comparable to those for probability sampling approaches however, nonprobability sampling strategies have a limited generalisability (Hammarberg, Kirkman and de Lacey 2016). However, quota sampling offers qualitative researchers an alternative to increase representativeness of the sample in nonprobability sampling same as probability sampling in a quantitative study.

(iii) Convenience sampling strategy

Convenience sampling is nonprobability sampling strategy most utilised during the exploratory stage of a research study and is the most efficient technique of gathering basic information rapidly (Taylor, Bogdan and DeVault 2015). This

strategy is frequently used when a researcher has access to participants within a certain institution, company, business, and group. Convenience sampling enables researchers to get easy access to locations where they are likely to witness the social interactions that are the focus of their investigation (Patton 2016). Bryman and Bell (2019) show that pilot studies/pre-test can benefit from convenience sampling and can also be used to check the reliability of newly developed scales and create research ideas.

Convenience sampling has a number of flaws even though it helps to address many of the difficulties associated with sampling. In terms of generalisability of research findings, convenience sampling is the least dependable of all sample strategies in qualitative study (Cooper, White and White 2012). Furthermore, Yin (2016) indicates that convenience sampling is prone to provide an unknown level of inconsistency because the most conveniently available sources of information are unlikely to be the most useful sources. Convenience samples, on the other hand, are likely to induce unfavourable bias (Yin 2016). The fundamental objectives of qualitative research are not to reduce bias and increase generalisability. Convenience sample results are frequently assigned a low level of reliability (Taylor, Bogdan and DeVault 2015).

(iv) Purposive sampling as a strategy adopted for this study

Purposive sampling is a strategy where participants are chosen because of their distinctive features, experiences, attitudes, or perspectives (Cooper and Schindler 2014). A researcher sampling in this subjective approach gives no external, independent means of determining the typicality of the chosen participants. As a result, the purposive sampling strategy is also known as judgement sampling. The selection of participants is limited to certain individuals who can furnish the needed information to help the researcher in answering the research question (Taylor, Bogdan and DeVault 2015).

Non-probability purposive sampling strategy was used as it allows the researcher to target certain individuals, in this case, senior accounting executives. According to Etikan, Musa and Alkassim (2016), homogenous sampling allows the researcher to focus on participants who have certain or comparable features. Given the reduced sample size of the investigation, this further emphasises the

suitability of purposive sampling for this study. When a researcher chooses the phenomenological approach as a research technique, the purposive sampling strategy is applicable (Cooper, White and White 2012). Purposive sampling, according to Yilmaz (2013), is used to gain better insight and a wealth of information on the issue under research. According to Barbour (2001) purposive sampling strategy allows a researcher a discretion of any sample bias embedded in existing groups.

Purposive sampling strategy aims at ensuring that a researcher identifies a group of people who can provide relevant data in a well-organised manner (Taylor, Bogdan and DeVault 2015). The researcher purposively selects individuals based on their relevance to the topic under investigation. The current study examines the how accounting is influenced by Industry 4.0 in KwaZulu-Natal. According to Wagner *et al*. (2012), researchers must rely on their capacity to identify appropriate individuals who represent the population by employing a specific strategy related to the purposive sampling method. The targeted participants (professional accountants) exhibit certain qualities that are necessary to supply accurate and relevant information. Purposive samples are sometimes chosen after field studies on a group to ensure that particular categories of people or people who exhibit certain characteristics are included in the study (Berg 2001).

Purposive samples are frequently useful for researchers despite certain major drawbacks (for example, the inability to generalise the research findings) (Lune and Berg 2017). However, researchers' adopting a purposive sampling strategy intend to collect rich and in-depth information from participants rather than focusing on the representativeness of the population.

3.11 Sample size

Interpretivist researchers do not need a big sample size in their studies. The sample size for this study was 13 participants. The participants who are accountants were purposively selected with the view that they possess a wealth of knowledge to help the researcher to answer the research questions. A sample size of 5 to 25 people is recommended for semi-structured interviews (Saunders, Lewis and Thornhill 2015). For phenomenological research, sample sizes

typically vary from one to ten participants (Starks and Trinidad 2007). Furthermore, Starks and Trinidad (2007) state that large samples are not required to obtain rich data sets in qualitative research. This is because qualitative researchers employ the principle of theoretical saturation to determine the appropriate sample size. Theoretical saturation is frequently used to argue for an acceptable sample size in a qualitative study (Corbin and Strauss 1990). Furthermore, Corbin and Strauss (2018) explain that saturation is "when no new categories or relevant themes are emerging". A saturation can be achieved with 12 interviews of a homogeneous group (Guest, Bunce, and Johnson 2006). According to a study by Francis *et al.* (2010), saturation can be achieved with sample sizes of 12 to 13 interviews. Furthermore, Kuzel (1992) indicates that for qualitative studies using in-depth interviews, 6 to 8 in-depth interviews for a homogeneous sample are adequate.

3.12 Trustworthiness of the study

Rather than adopting the vocabulary of positivist researchers, interpretivist researchers strive to describe what reliability and validity mean in positivist terms using their own vocabulary (Yilmaz 2013). The level of confidence in the information, interpretation, and strategies adopted to ensure the integrity of a qualitative study is referred to as the study's trustworthiness (Pilot and Beck 2014). It is therefore recommended that researchers should explain the procedures and methods employed for a study to be considered worthy of readers' attention (Amankwaa 2016). The foundation of dependable qualitative research is the trustworthiness of outcomes. The study adopts Lincoln and Guba (1985) ideas of credibility, transferability, dependability, and confirmability to illustrate the quantitative concepts of internal validity, external validity (generalisability), reliability, and objectivity to measure the rigour of qualitative study.

(i) Credibility

Longer interaction with participants, peer-debriefing, persistent observation, member-checking, and reflective journaling are all employed to enhance credibility (Connelly 2016). A properly structured research process, clear records of how each step of the research was conducted, and a description of the

research's strength and weaknesses in the final report provide a researcher assurance that they are presenting true results (Kyngäs, Kääriäinen and Elo 2020). The researcher explained to participants that their participation in the study was not compulsory using informed consent and assured them that no participant would be exposed to any danger during the study. Every participant who was contacted was given the option of declining to join in the research study. This ensured that only those participants who are honestly interested in taking part and willing to voluntarily submit data are included in the data gathering sessions.

When a researcher considers the credibility of their study, they need to reflect on their own experiences, beliefs about the issue being studied, and the setting in which the investigation will take place (Kyngäs, Kääriäinen and Elo 2020). The researcher committed a substantial amount of time interviewing participants. To strengthen the researcher's interviewing ability, he consulted colleagues, experienced researchers, and relevant literature. The researcher concentrated on the information from the participants' during the interview sessions, but he was also mindful of their tone as well as any conflicting remarks expressed. These remarks were recorded in the researcher's field notes, adding to the richness of the analysed data.

Shelton (2004) suggests that some participants may be requested to read transcripts of any conversations in which they took part to improve the credibility of the study. To ensure accuracy, each participant was contacted about their data collection and analysis. In addition, the researcher did the transcriptions of the data personally, which added to the extended interaction with the collected data. After transcribing the collected data, the researcher analysed the data by breaking it in little chunks to increase familiarity with the data which added to the in-depth interpretation and analysis of the data. Three experienced peers with credibility in the academic research assessed themes, categories, sub-categories, codes, and the interpretation of the research findings. Peer review provides validation for the research study. Peer review adds credibility to the research findings and increases its acceptance by other academics (Lee, Sugimoto and Zhang 2013). The feedback provided by peer reviewers helps researchers to improve their research. Reviewers may suggest additional

experiments, point out gaps in the argument, or recommend changes to the presentation of the findings. This feedback can enhance the clarity, depth, and impact of the research (Bornmann 2011).

In addition to taking notes on the developing themes, the researcher also observed his own reactions to the research findings. The researcher established credibility by detailing what was done and why certain data gathering decisions were made. Furthermore, a comprehensive literature evaluation informed the study's structure and design. Yilmaz (2013) points out that for qualitative research to be trustworthy and credible the data should be adequately descriptive and include in-depth description of persons, interactions, activities, and locations so that the individual who reads or reviewer can comprehend what happened and how it happened.

(ii) Transferability

Cooper, White and White (2012) describe transferability as the degree to which study results can be applied in different contexts. As part of the planning phase of the study, a researcher should consider transferability by thoroughly explaining the sampling methods as well as the potential inclusion criteria and the key characteristics of participants so that other researchers could verify if the conclusions derived from the sample can be applied to other situations (Kyngäs, Kääriäinen and Elo 2020).

The researcher explained in detail all background material to both stages to enable transferability. The researcher included an explanation of the interview process, as well as information about the participants and their surroundings. This would enable further comparisons and provide readers with a thorough knowledge of the study. According to Firestone (1993), it is the researcher's duty to make sure that adequate contextual data regarding the fieldwork sites is presented.

The researcher employed qualitative semi structured telephone interviews as a data collection tool. Semi-structured interviews enabled the researcher to gather in-depth information from the participant on how accounting is influenced by Industry 4.0 due to the researchers' ability to pose probing questions which elicited further responses. Guba (1981) is of the view that gathering data with

detailed descriptions of the issue under investigation can also assure transferability. Additionally, transferability can also be improved by incorporating or adopting techniques such as explaining how participants or the sample was chosen and describing their features, which lets readers to make their own decisions (Wu *et al*. 2016).

Every researcher has the responsibility to present sufficient and detailed data about their research so that other readers may determine whether the study findings are applicable to different situations. Moretti *et al*. (2011) opine that it is critical to clarify the criteria and principles the researcher used to recruit participants, as well as their primary characteristics so that the findings may be assessed for transferability to other settings. The selected participants who are accountants share certain characteristics that are required to provide accurate and meaningful information.

This is because the right sample size for qualitative studies is dependent on the data richness. However, Morrow (2005) indicates that qualitative data cannot be stated to be generalisable to the study population in the traditional sense because of the small sample sizes and lack of statistical studies.

(iii) Dependability

Dependability is a criterion that is related to reliability in that it is concerned with the consistency of research findings over time (Sinkovics, Penz and Ghauri 2008). The concept of dependability indicates that results of the study are unique to a certain time and place and that interpretations are consistent throughout the data. The researcher ensured dependability by systematically reporting all the themes throughout the transcript. In addition, a researcher included tables, figures and attachments that clarify the categorisation method as part of his final report. The primary concern of dependability is with the consistency of study beginning point, data gathering, and analysis.

The research exercise was detailed and coherent, and full descriptions of methodological procedures were given to allow the study to be transferable. The researcher explained the research strategy, participant demographics, and the research setting. Beck and Polit (2018) suggest that maintaining a decision trail that outlines the researcher's decision criteria for categorising data and drawing

analytic conclusions is an effective technique to improve the study's dependability. Maintaining an audit trail of peer-debriefings with a colleague and process logs are two procedures for ensuring dependability (Connelly 2016).

To ensure dependability in this study, the researcher kept audio recordings of the interviews, notes made during the interview, interview transcripts and decisions made during data analysis. This enables colleagues to audit whether proper procedures were followed during the research study. Researchers should request peers who are experienced with the research topic to examine the findings and give their honest thoughts on study credibility because feedback from a colleague is important for study credibility (Kyngäs, Kääriäinen and Elo 2020).

(iv) Confirmability

According to Kumar (2016), confirmability refers to how easily other researchers could confirm and corroborate the findings of qualitative study. Interpretivist researchers equate confirmability in qualitative research to reliability in quantitative study. Beck and Polit (2018) point out that for research study to meet the requirement of confirmability, the findings must capture the participants' voices and the context of the inquiry, not the researcher's biases or viewpoints. This indicates that the data represents the views that participants submitted rather than representing researcher opinions.

Lincoln and Guba (1985) assert that it is important for a researcher to assess if their results are exclusively made up by the data gathered from the participants, or whether they also show the researcher's bias. It is in this section that the researcher discloses any shortcomings in the methodology used. To ensure the integrity of the research outcomes, the researcher gave a detailed methodological explanation of the procedures taken through the research study. In addition, the researcher utilised diagrams to display an audit trail, which showed how data was collected and analysed throughout the research, ultimately resulted in the creation of recommendations.

3.13 Data analysis

Qualitative analysis begins with a holistic interpretation of the research phenomenon (Dey 1993). This may be done by reading observation notes and interview scripts. The researcher's initial reading of data will lead to memos and notes as well as preliminary ideas about how the data is organised and how it fits together. Once data has been gathered from in-depth interviews, open coding is the phase where analysis starts (Charmaz 2014). While coding interviews, the researcher gets a deep look at the experiences of the participants and can identify underlying comments and issues from the data (Charmaz 2014).

Coding integrates material that the researcher had previously broken down and isolated during the open coding stage and arranges it in new manner by integrating categories and subcategories (Strauss and Corbin 1990). Strauss and Corbin (2013) explain that this procedure is done when a researcher reassembles or integrates data in a logical manner to determine if there is a relationship between the categories. During coding, categories were linked to respective subcategories to produce more specific and thorough explanations which were then grouped under each category as themes. The researcher continues to code until no significant new information emerges from the data. Coding also seeks to ascertain the category of aspects that led to the phenomenon as well as the context in which it occurs (Strauss and Corbin 1998), in this study the researcher investigates how Industry 4.0 is influencing accounting practices.

3.13.1 Thematic analysis

Thematic analysis is frequently considered of as a broad method of analysing qualitative data. NVivo version 12 software was used to aid data analysis. In qualitative research, data analysis entails preparing and arranging the data for analysis, breaking the information into themes using coding and then presenting the information in a discussion or graphically (Creswell and Poth 2018). This process enables the researcher to derive meaning, trends, and patterns from the collected information. Adhabi and Anozie (2017) describe thematic analysis as a technique for methodically identifying, organising and interpreting patterns of themes in a large amount of information. Saunders, Lewis and Thornhill (2019)

compared qualitative data analysis to putting together a jigsaw puzzle with the pieces representing data. The relationship between these pieces of data enables researchers to establish a sense of what they think the data is revealing.

Braun and Clarke (2006) provide a six-step method that can direct thematic analysis research. The data analysis was guided by Braun and Clarke's (2006) six-phase methodology.

Phase one: In this phase, the researcher familiarised with the data by repeatedly reading transcripts, listening to audio recordings, and taking notes as they are read. Following the six-step methodology outlined by Braun and Clarke (2006), the researcher began the process of data analysis by first listening to the audio recording and then individually transcribing each interview. It was during the transcription procedure that the researcher first began to become familiar with the information. After transcribing the interviews, the researcher read the transcribed transcripts to get a better understanding of what was said and to make notes. The researcher was able to gain an understanding of the material and identify relevant parts after readings the transcripts several times.

Phase two: creating the initial codes; during this stage, the data are rigorously coded and analysed. The researcher assigned codes to the parts of the information that I believed to be relevant. According to Braun and Clarke's (2006) six-step process, the researcher selected and categorised potentially significant aspects of the data. The researcher coded data properly to enable data reduction when sorting through massive amounts of data, and the procedure was complete when all data had been coded.

Finding the theme is the third phase. The codes start to change into themes, and themes identify key ideas about the data that are pertinent to the study objectives. The researcher generates the themes by going over the codes and reflecting on the recurring patterns in the data.

Phase four: entails reviewing themes to see how well they fit the coded data, as well as making any necessary adjustments. The first step involves comparing themes to the collected data extracts and identifying a coherent pattern.

Braun and Clarke (2006) provided a six-phase procedure that can direct researchers utilising thematic analysis. This process is how themes were produced in this study. The data analysis was guided by Braun and Clarke's (2006) six-phase methodology.

Defining and labelling themes is the fifth phase. In order to provide a clear and comprehensive definition of the themes, a researcher must elaborate on what makes each of them distinct. In-depth data analysis is also included in this stage. The purpose of this phase was to further develop and define themes so that they can better assist the audience in comprehending the material. The themes were succinctly stated so that it would be simple to comprehend what they meant and how they related to the data.

Phase 6: Is when a report is compiled, which offers a compelling insight on the accuracy of the data analysis procedure. This phase entails writing the report. After the analysis procedure was complete, the results were presented during this phase.

3.14 Ethical consideration

Research ethics are moral standards that underpin the planning, collecting, and execution of a research project. In performing the research, it is the researcher's responsibility to offer recognition to partiality and truthfulness. The researcher underwent TTREE ethics training in which a certificate was awarded upon passing the assessment and it is attached in the Appendix. TTREE training gave a researcher a comprehensive understanding of research ethics. Essential ethical considerations relating to researcher obligation often guide research in the human sciences. Several ethical considerations were addressed, including informed consent, anonymity, and confidentiality, securing authorisation, and no harm. The researcher respected the rights of all participants in the research by adhering to all ethical requirements that applied to each participant, as listed below:

(i) Informed consent and Voluntary participation

Saunders, Lewis and Thornhill (2019) explain that “Informed consent involves researchers providing sufficient information and assurances about taking part to

allow individuals to understand the implications of participation and to reach a fully informed, considered and freely given decision about whether or not to do so, without the exercise of any pressure or coercion". The researcher offered participants an opportunity to ask questions and to think about their participation in the study. The researcher indicated to the participants that they had the discretion to stop participating in the study at any time. This means that participants have the option to withdraw from the study and potentially the information they have submitted. To participate in the study, participants were required to sign consent forms, indicating that they understood the terms and conditions of participation and that they did so voluntarily. Additionally, none of the participants were forced or coerced into taking part in the study.

(ii) Confidentiality of the participants and data

Confidentiality of the interview setting was maintained with care throughout the telephone communication and interview session as well as data processing and distribution of the findings. Gray (2013) concludes that there is a good chance that data reliability will increase if a researcher promises to guarantee the confidentiality of the participants. To maintain confidentiality in this study, each interview was done in a secure and quiet environment with no other people present. This is because unauthorised identification of the participants can cause negative consequences. Therefore, telephone interviews may boost participants' sense of anonymity (Greenfield, Midanik and Rogers 2000). Telephone interviews foster a sense of confidentiality for the interviewee, allowing them to be more honest and open, especially when dealing with more delicate matters. The collected data will be used just for this research study and securely saved, and password protected so that no one other than the researcher and supervisor have access to it.

(iii) Anonymity of the participants

Participants' anonymity was protected by withholding their names and identifying information during the study's data collecting, analysis, and presentation of the results. Richards and Schwartz (2002) maintain that research transcripts should be written using pseudonyms or initials, and any other information that may identify the participant should be changed. The researcher used pseudonyms

names throughout the study to ensure that the participants' identities remained undisclosed. In addition, the researcher ensured the confidentiality of the participating accounting firms while preventing the unauthorised use of the collected information. Anonymity guarantees that only the research may know who took part in study and that no one can trace the participants.

(iv) Beneficence and non-maleficence to the participants

The researcher is responsible for ensuring the safety of all participants. Eddie (1994) asserts that beneficence and non-maleficence are the most important ethical principles that apply to any scientific study. Participant's safety was not jeopardised in any way, be it physically or emotionally. In addition, the researcher explained to the participants to indicate any aspects that could cause unintended harm to them. Adhabi and Anozie (2017) indicate that harm can be induced by utilising aggressive research strategies that involve psychological and social pressure, resulting in anxiety or stress. The researcher minimised any potential danger to participants during the entire study. However, participants will benefit from the research findings that will be shared with them as well as the rest of the industry.

(v) Obtaining permission to conduct the study

Before conducting the interviews, a formal request for permission to conduct the study was made to the accounting firms, which was approved. Appendix contains copies of the accountancy firms' approval letters. To ensure the study's trustworthiness, the researcher followed the Durban University of Technology's (DUT) ethical policy and guidelines. A copy of the interview questionnaire and Gate Keeper's letters from the participating firms were attached to the University's Ethical Clearance Application Form. Durban University of Technology's Faculty Research Committee approved the study. As evidenced by the gate keeper's letters, permission was officially requested from the participating firms. To avoid plagiarism, all literature used in this study is properly credited and referenced.

3.15 Conclusion

Chapter three discussed the techniques employed by the researcher for collecting and analysing the collected data. The study adopted a qualitative research method as the study was seeking to gain in-depth knowledge on how Industry 4.0 is impacting the work of accounts. This chapter discussed different philosophical perspectives and the researcher believed that interpretivism was the most appropriate research philosophy for this study. Interpretivism is useful for researchers who want to learn about perceptions, feelings, and experiences of participants. The study adopted phenomenological research strategy to help the researcher capture the lived experiences of the participants regarding the impact of Industry 4.0 on the work of accountants. This necessitated the researcher to use open ended questions. Moreover, open ended questions enable participants to bring up more issues relevant to the research problem and the researcher can also follow up with probing questions. In-depth telephonic interviews were adopted as an appropriate data collection strategy. Thematic analysis was appropriate for analysing the collected data. In addition, the chapter also discussed data control techniques. The last section of this chapter focused on ethical considerations. Research ethics are moral standards that underpin the research project.

The interpretivist approach is the study's methodological contribution. This is because conventional accounting studies have tended to follow a positivist tradition of interpretation (Coetsee 2011). The positivist tradition of accounting research is still prevalent in South Africa, while there has been a rise in studies performed within an interpretivist paradigm on a global scale (Coetsee and Stegmann 2012; Maroun and Jonker 2014). The qualitative research approach is appropriate because the possible answer to the research question requires an explanation from the participants rather than a simple No or Yes. In addition, qualitative research methods are most suited for studying real-world practices when the aim is to understand "how" and "why" (Yapa, Jalathge and Siriwardhane 2017).

The next chapter details the presentation, interpretation and discussion of results.

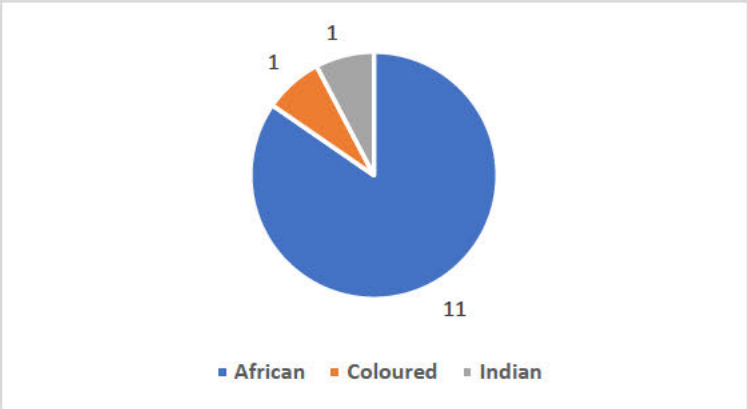
CHAPTER 4. PRESENTATION AND DISCUSSION OF FINDINGS- THEME- ONE

4.1 Introduction

Theme one presents and discusses research findings on how Industry 4.0 is influencing accounting practices and the opportunities that emerge from the adoption of these technologies. These findings are based on participants' own experiences on how accounting is influenced by Industry 4.0 and the opportunities it presents. The analysis of the results shows how Industry 4.0 is transforming conventional accounting practices through automation. The integration of machine learning and artificial intelligence into financial reporting has revolutionised accounting systems and the manner in which accounting tasks are performed. The findings are discussed in detail, highlighting how Industry 4.0 is changing conventional accounting procedures through enhanced data analysis, increasing automation, and faster decision-making.

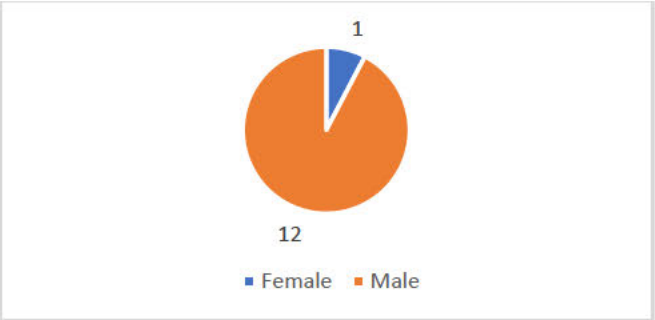
4.2 Part A: Demographic information

Figure 4. 1 Racial distribution of participants



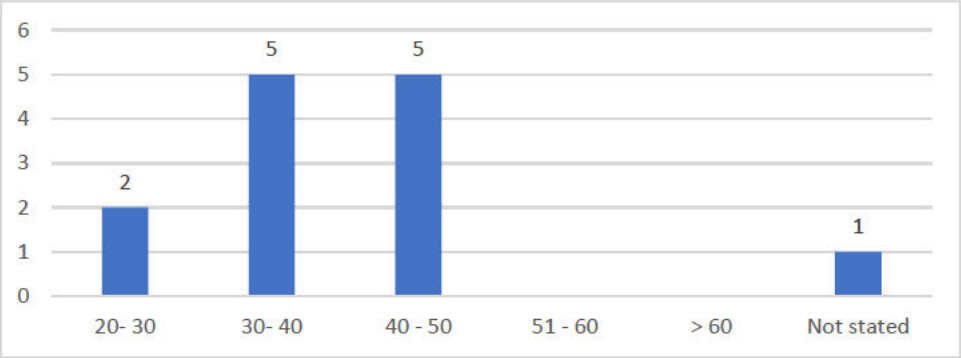
The majority of the participants were African. This could be associated with the population in the province. Shabalala, Ghai and Okpeku (2023) indicate that black people (African) account for 80 per cent of the population in KwaZulu-Natal province.

Figure 4. 2 Gender distribution of participants



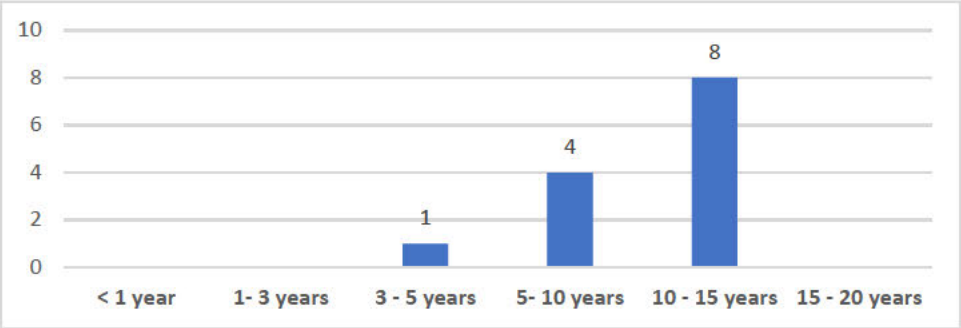
The majority of participants were male, which can indicate a highly male dominated sector. According to AccountancySA (2023) African women accounted for 3 per cent of the 26 000 Chartered Accountants in South Africa.

Figure 4. 3 Age distribution of participants



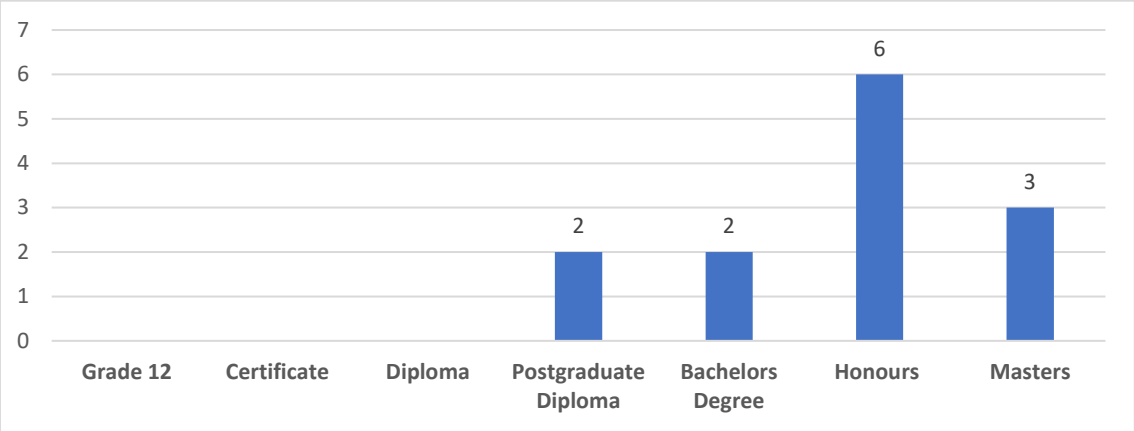
The majority of participants were above the age of 30, thus indicating maturity and experience.

Figure 4. 4 Years of Experience of participants



Majority of r participants had over 5 years of experience with a high number having over 10 years of experience. This expresses that the respondents were seasoned and highly qualified.

Figure 4. 5 Education level of participants



The majority of the participants had degrees and higher qualifications, thus indicating a high level of education and qualification in their field.

4.3 Theme one: the influence and opportunities of Industry 4.0 in accounting

This primary theme examined the key aspect of the influence and opportunities of Industry 4.0 on the accounting fraternity. Figure: 4.6 and 4.7 below shows a graphic representation of frequently mentioned words in relation to the influence of Industry 4.0 on accounting practices and the opportunities it presents for the accounting sector. The larger the bubble, indicates the higher frequency of words and the larger the size of the node implies the more concentration of responses in that area. Participants indicated that real-time information, cloud accounting, cloud storage, automation, collaboration and paperless transactions are some of the different ways in which Industry 4.0 has influenced accounting practices. Industry 4.0 has also brought some opportunities to the accounting sector. For instance, improved data process, cost saving, productivity, communication and improvement in error and anomaly detection.

Figure 4. 6 Cluster analysis

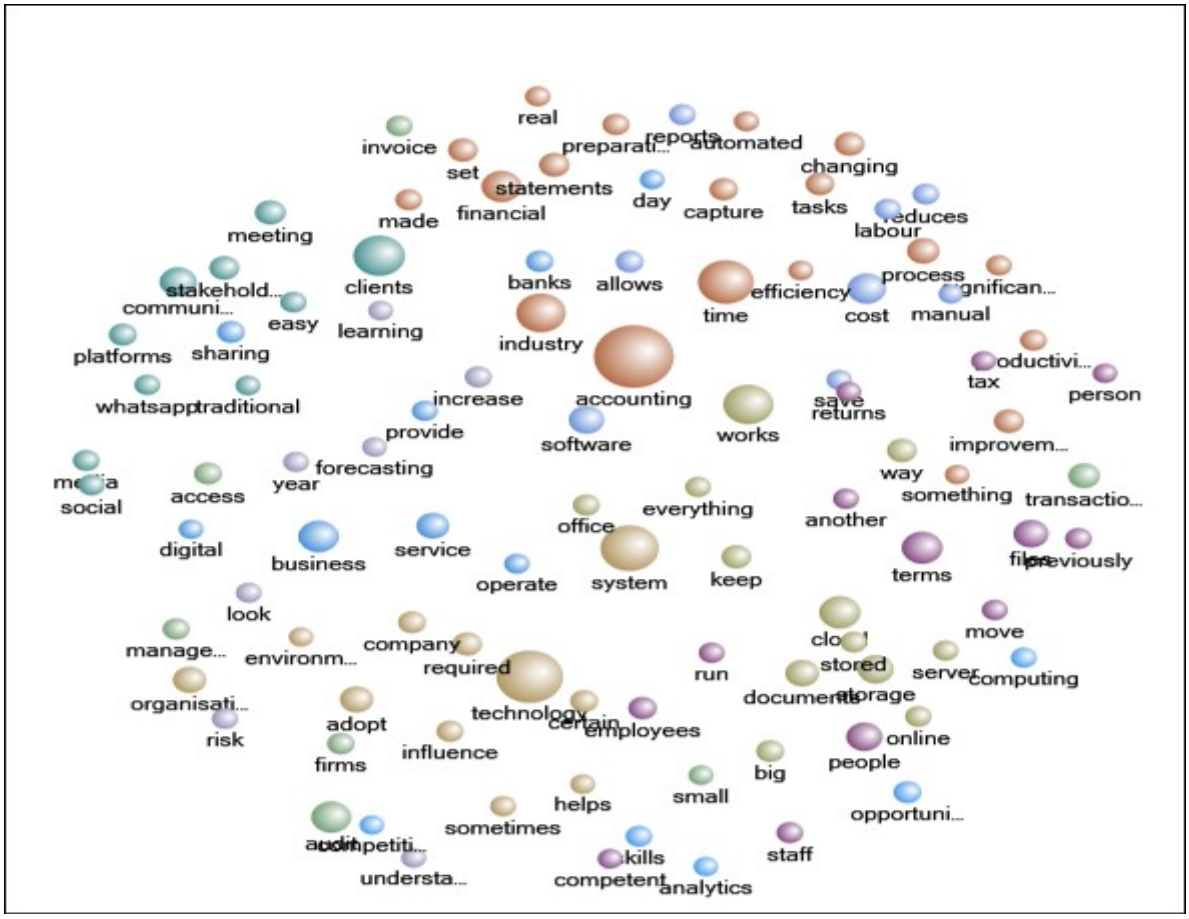
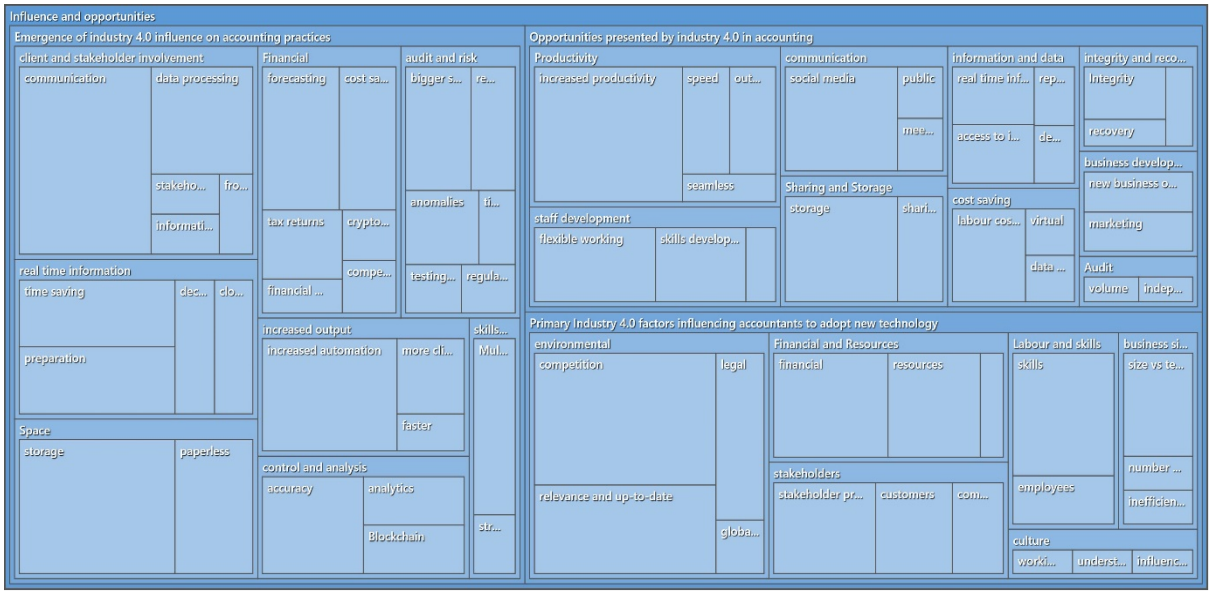


Figure 4. 7 Hierarchy Charts



4.3.1 Sub-theme 1: Emergence of Industry 4.0 influence on accounting practicesl

The emergence of Industry 4.0 has brought about a significance influent on accounting practices. Technological advancements are transforming financial reporting. The emergence of Industry 4.0 has considerably influenced the adoption of digital platforms by firms to both disseminate and compile real-time financial reports. Notwithstanding these benefits, new threats including fraud, data breaches, and cybercrime have surfaced.

4.3.1.1 Audit and risk

The Audit and Risk component seemed to have been highly influenced by Industry 4.0. The audit procedure might be altered by blockchain. Due to the immutable nature of the blockchain's distributed ledger, there will be no need for auditors to manually collect and verify information from trading partners. Audit teams leverage modern technologies for risk monitoring, identification of fictitious transactions and data analysis for anomaly disclosure. The emergence of Industry 4.0 has had a substantial influence on how firms evaluate their internal controls and handle risk.

4.3.1.2 Regular auditing

Auditing can now be done regularly rather than periodically. It does not have to be scheduled specifically as per previous manual methods. This means that auditing process can be continuously monitored. Industry 4.0 has enabled a paradigm shift that has increased accessibility and facilitated access to data. This makes constant auditing crucial in preventing the risks emerging from the use of Industry 4.0 technologies. Participant **#5** suggests that accountants can audit continuously due to availability of information.

“If you were to audit, then you will have to audit at the point in time so you could do your auditing halfway maybe for six months’ time or you can come back at the end of the year and complete auditing… but now with Industry 4.0 accountants can continuously audit. So you can plan your audit for the financial year by setting the key areas you want to audit and these key areas use this system and so I know if the controls are working this needs to happen… so you can track what is happening throughout the year… then you can see if my controls are working

throughout the year or they are just working at certain point in time and you can also check the bigger sample in terms of auditing".

The above statement by **#5** reveals that the emergence of Industry 4.0 enables continuous audit. Dai and Vasarhelyi (2017) state that in the audit 4.0 ecosystem, auditors can remotely perform continuous auditing, anomaly detection and monitoring. Kaplan (2021) found that adopting blockchain technology in accounting will make it possible to conduct constant audits of all blockchain transactions in real-time, rather than just a random sample of them. The fact that information is confirmed and available right away also makes it easier to set up a continuous audit. Real-time financial reporting has necessitated regular audits to assure the correctness and dependability of the financial information presented. Cetinoglu (2021) explain that continuous auditing is a procedure that combines real-time reporting with auditing the concerns highlighted by the audit soon after the incident.

4.3.1.3 Anomalies detection

The automation of the auditing process allows for more anomalies and errors to be detected. Furthermore, bulk transactions and data can be captured with minimal to zero errors. Industry 4.0 can present internal auditors with a more thorough and precise list of anomalies. It is possible for businesses to run into trouble in today's era of real-time financial reporting if audits are not performed frequently enough to catch errors and fraud. Constant auditing is amongst the finest approaches to avoid this situation.

Participant **#4** believes that implementing modern technologies improves error detection in financial transactions.

"from what I've seen how continuous auditing should be working is essentially they rely on a system. I'm not sure if the audit firms develop that system or SAP or Pastel development software then that software will give you your exception…that software will run through all the transactions and tell you you're normally so for example if only John posts revenue general journals and suddenly Ken post a journal at year end that software will pick up that anomaly that something is wrong it doesn't follow the normal pattern of transactions and

therefore the auditors will audit that on a continuous basis or maybe every month, every quarter every half year so that's how I envisioned it working".

Participant **#13** shares a similar sentiment with #4 on the impact of advanced technologies presented by Industry 4.0 in detecting anomalies and errors in financial statements.

"Manual capturing of data which is going to contain a lot of errors and so forth and in terms of risk assessment, the technology comes with build in risk assessment modules which means they are actually embedded with an audit trail that links transactions. There is a risk that data may not be correct so it flags certain items and certain figures as you go because it's taking data from the Internet, taking data from the organisational database and making this data to the assumptions and comes up with the logic and this system can actually detect any fraudulent input of data onto this system".

The automation of the auditing process allows for more anomalies and errors to be detected. The findings are in line with the study by Aksoy and Gurol (2021) who found that artificial intelligence gives new control options for preventing errors through continuous monitoring. Furthermore, in the blockchain ecosystem, an error alert is generated, and the transaction would need to be re-evaluated if one or more of the rules inherent in the smart contract are violated (Rozario and Vasarhelyi 2018). The adoption of Computer Assisted Audit Tools and Techniques (CAATT) in the accounting sector aids auditors in detecting anomalies in financial transactions and enables them to conduct an in-depth analysis of the transactions cost effectively with greater evidence at a lesser risk. Audits can be performed efficiently due to the availability of fast and user-friendly audit software. Modern technologies presented by Industry 4.0 enable auditors to analyse the entire population rather than basing their opinion on small sample size.

4.3.1.4 Time and speed

The time and speed of auditing is improved. Due to electronic information upload, the speed of auditing can be seen as seamless. The time taken to audit is greatly reduced due to electronic processes. Previously, an audit was done physically which entailed more physical time, resources, and material.

Participant **#4** highlights that the time and speed of auditing have improved as a result of Industry 4.0 implementation.

"the reporting and the use of accounting software has increased in order to keep up with the demand for data analytics. Gathering of information depends on the circumstances but people can now gather the information electronically, so from an audit perspective for example where we would have asked for physical invoices we are now asking for PDFs because we can use data sniper and other tools to extract information from that PDF scan, we don't have to look at the invoice ourselves physically we can do it faster with data analytics".

The above views reveal that the time taken to audit is reduced due to electronic processes. The finding of the study aligns with Arrowsmith (2021) who explains that wearable technology such as smart glasses can improve audit efficiency and effectiveness. With the advent of blockchain technology, resources that were used for gathering and analysing information will be freed up (Liu *et al*. 2019). Industry 4.0 has enabled the implementation of new CAATTs and Integrated Audit Software, which have improved the accuracy of audit reports, shortened auditing times, and cut costs (Aksoy and Gurol 2021). Traditionally an auditor had to visit a client's premises to conduct an inventory count but the introduction of smart glasses in auditing have significantly transformed how auditor conduct inventory count.

4.3.1.5 Bigger samples

Bigger samples and even entire populations of data can be audited as compared to previous small manual samples. The ability of the auditors to test the entire population accords more credibility to the audit report. In addition, most conventional methods of analysis depend on taking samples of audit-related information.

Participant **#13** shared the following views on the influence of Industry 4.0 in auditing.

"where before Industry 4.0 we would just base our judgment on a selected sample, and you didn't have to test the whole population but now with most documents on an electronic version you can basically audit the whole entire

population you don't have to depend on the sample and then have to extrapolate".

Participant **#6** concurs with **#13** that auditors are now able to audit the whole population rather than a sample.

"Industry 4.0 has also brought a lot of changes in auditing, previously you could only sample a few transactions and base your judgment on that, but now an auditor has the ability to audit the whole sample, but also these new technologies enable continuous auditing because the information is available to them, for example, technologies like blockchain has the ability to enable continuous auditing".

Participant **#8** expressed the following views based on his experience. The views are similar to what other participants said.

"Auditors are now using data analysis tools to extract large amounts of data from a client's financial records and use that information to identify patterns and reveal anomalies across the entire range of entries. Because of the new technologies, there are many accounting tasks that these new technologies can effectively perform".

The views expressed by #13, #8, and #6 reveal that the adoption of advanced technology in auditing enables the auditor to test the entire population rather than basing the opinion on the small sample size. Audit analytics improve the audit scope from a small percentage of transactions to a complete population testing (Dai, Vasarhelyi and Medinets 2019). This increases the examined population from a small sample size to a whole population. Modern data analytics software can retrieve information stored in different types and structures which is too much for conventional analysis methods to handle. The implementation of audit data analytics reduces the cost and time spent gathering evidence. Additionally, a lot of data analytics methods are scalable in the sense that they usually sustain their effectiveness while dealing with large and complex data (Hariri, Fredericks and Bowers 2019). The adoption of technologies like enterprise resource planning (ERP), blockchain, artificial intelligence, IoT and big data by many organisations is increasing and it is no longer possible to gather enough assurance from a data sample. In addition, Freiman, Kim and Vasarhelyi (2022) assert that adopting

CAAT would make it possible to test ledger records and electronic transactions in greater detail, which could be helpful if the auditor wants to change the scope of the testing. Therefore, the old technique employed by the audit profession may be ineffective in providing assurance because of the vast amount of data generated by Industry 4.0.

4.3.1.6 Remote

Auditing can be done remotely and efficiently without having to physically go to the client's premises. This again is due to electronic information and documentation. Anything that would normally be checked during an in-person audit will instead be checked by technological solutions. Audits conducted remotely take as much time as those conducted in person and necessitate the same amount of cooperation from the audit client.

Participant **#6** explains that auditors can now conduct audits remotely because of modern technologies.

"We have also seen the emergence of audit lens which helps auditors to conduct asset verification remotely or conduct stock take remotely".

Participant **#11** shared the following views.

"Previously auditors had to come to your organisation to conduct physical audit where auditor spent hours opening files and documents which was a very costly exercise, but now you can actually give them to login to your account package and they can login remotely and they can access your general ledger, check the general ledger accounts because verified source documents can actually be attached onto the system. So, they can just go to the transaction there is an attachment with the source document so they can verify all those things like the accuracy of the existence of certain transactions with less wastage of time and resources. Imagine long time they had to dispatch a team of about three or four audit juniors in the organisation to collect data which they can now do at the comfort of their office".

The views shared by participant **#6** and **#13** reveal that advancement in information and communication technology enables auditors to conduct auditing remotely. The real-time, two-way connections enabled by wearable technology

like smart glasses allow auditors to remotely observe inventories with the exact accuracy as they would on-site during stock count (Bishop 2021). Rather than wasting time and money travelling to physically inspect paperwork, most information can be accessed remotely from any location via a cloud portal. The finding is further supported by Serag and Daoud (2021) who maintain that auditors can leverage technology to acquire relevant information and conduct audits remotely. With remote auditing, auditors can save both time and money by not having to physically visit each audit site. Many businesses now use online conferencing tools like Zoom, MS Teams and other video conferencing applications which makes them ideal for conducting interviews and doing on-site observations. The goal is to assess data objectively in order to gauge how well the audit requirements have been met. Tools like file and screen sharing, video calling, and real-time data analysis can all be used during remote auditing. With the help of contemporary software, auditors can implement the standard auditing methodologies normally employ at on-site audits.

4.3.1.7 Client and stakeholder involvement

Industry 4.0 has influenced client and stakeholder involvement in the following ways.

4.3.1.7.1 Communication

Quick and easy communication with stakeholders was greatly facilitated. Virtual communication was possible through virtual platforms such as ZOOM, Teams, and other digital platforms. Previously, physical meetings took longer, more resources, logistics and costs. Moreover, Social Media platforms such as WhatsApp, Twitter, and Facebook allowed for easy and seamless interaction with clients as opposed to only being limited to physical meetings and phone calls.

Participant **#7** believes that the emergence of Industry 4.0 has influenced the communication between accountants and clients.

“The outbreak of coronaviruses meant that some of us had to work hybrid in the office and outside the office and that means now meeting stakeholders we have to find other ways in which we can try to communicate instead of meeting

physically. We had to familiarise ourselves with tools like Microsoft Teams and Zoom meetings".

Participant **#2** had the following to say on how the advent of Industry 4.0 has influenced the communication between accountants and clients.

"So, with systems being more automated and smarter it definitely improved the communication channel between accountant and client… so we can easily send any information that the client needs through WhatsApp application, and they can access it immediately at any time and you can also see that it was delivered, and they have read it".

Participant **#6** shared similar sentiments with other participants on how Industry 4.0 is influencing communication between accountants and their clients.

"But also, accountants can now communicate with stakeholders using different platforms. For example, using social media most of organisations now have social media accounts and some of them use this platform to send out or share information. Social media can also help auditors to gather information about the new client before signing an engagement letter".

The above statements show that communication between accountants and their stakeholders has been made easy and seamless by the advent of social media and other communication platforms. This research finding aligns with Boylan and Boylan (2017) who found that social media allows businesses to disseminate their financial records to the public without relying on traditional methods. In the age of Industry 4.0, individuals constantly engage in the process of constructing a collective truth using social media, which functions as a multiplier of users' opinions (Pace, Balboni and Gistri 2017). Due to this, social media has established itself as a trustworthy platform for gathering insightful worldwide online stakeholders' feedback that can be used in data analysis. These days, many businesses use multiple social media platforms to make sure their messages reach their customers. However, social media allows an organisation to control the kind of information they disseminate to the public in case of bankruptcy or negative financial performance (Etter, Ravasi and Colleoni 2019). In addition, social media offers a chance for a firm to interact with its customers on a range of issues such as financial statement disclosure. Additionally,

company disclosures such as earnings announcements and other important market news have been disseminated through social media. According to Ding, Zhou and Li (2020) businesses are increasingly using social media to share their finances information and annual reports.

4.3.1.7.2 Stakeholder understanding

Stakeholder understanding was induced through Industry 4.0 and stakeholders could now receive data in pictorial depictions and different types of the analysis presented by Industry 4.0 technology. Getting cost-effective means to analyse the expanding volumes of data generated from Industry 4.0 is becoming more imperative for many organisations. It is becoming impossible to keep up with the amount of accounting data generated by Industry 4.0.

Participant **#11** believes that when financial information is presented in a visual manner it enhances the understanding of stakeholders with less knowledge in accounting.

"We are also looking at other techniques like visualisation which makes the interpretation of financial statements very easy because some of the stakeholders are not learned in terms of financials… they want data that is easily accessible and easily understandable. So the advent of systems like data visualisation that can give a pictural representation of the financials like key metrics for those people to understand ratio analysis which has actually reduced the cost of reporting to such extent that the resources that could have been used for financial reporting can now be used elsewhere in the organisation".

The finding of the study reveals that data visualisation and interactive technology improve the understanding of financial information. Interactive data visualisation helps non-professional stakeholders to make more informed financial decisions with less intellectual effort (Perdana, Robb and Rohde 2019). With interactive data visualisation managers with basic knowledge on financial statements can execute complex investment decisions. Data visualisation enables investors and other stakeholders to easily absorb and digest important data, which enhances their ability to make decisions. The research finding of the study is supported by Khoja, Chipulu and Jayasekera (2019) who explain that making information more engaging through interactive visualisation is crucial for assisting stakeholders in

making better decisions. Even when the data being presented is structured or unstructured graphical illustration and interactive technology can aid in understanding and analysing the data. With the use of visualisations, stakeholders can understand and draw meaningful conclusions from the information. Interactive capabilities of visualisation software help non-experts understand content in greater depth than conventional presentations Individuals with less or no knowledge in accounting can understand financial statement better with visual presentation rather than tabular representations of data.

4.3.1.7.3 Information sharing

Information sharing via interactive storage such as cloud technology allows for frequent and secure information sharing thus enhancing transparency and knowledgeability. Clients are more involved in data processing aspect due to online apps and features. They can get instant reports on all transactions via email. The latest online packages allow for all sorts of financial statements, reports and analytics to be available at the click of a button.

Participant **#11** suggests that information can now be shared fast and in large volume a cross digital platforms.

"Now you are able to share a large volume of files across digital platforms which was difficult in the past… it was difficult to share large files via Internet networks but now systems like Zoom, Microsoft Teams can allow us to exchange a large amount of data because they are using cloud storage system. Previous you had to have computer department where you actually house your server and transferring files was slow because files would que and sometimes the server would get clogged with a lot of information which you can't get now… so now files can be shared simultaneously across the web platform through WhatsApp, Microsoft teams and other virtual platform like drop box, Microsoft OneDrive".

The finding reveals that the advent of Industry 4.0 has enhanced information sharing which translates to improvement in productivity due to the availability of information in real time. The study finding is aligned with Chang and Wills (2017) who reveal that the increase in productivity was significantly greater on the Cloud storage compared to the non-cloud platform. Furthermore, Chang and Wills (2017) reveal that cloud technology resulted in shorter actual and predicted

runtimes compared to traditional computing infrastructure. Traditionally accounting practices depended on historical information to make decision, but Industry 4.0 is transforming accounting into real time practice whereby information stored in cloud is available immediately and accountant can access the information anytime from anywhere. In addition, the information is available in different formats and can be accessed using various devices. The availability of information in real time enhances the decision making by managers. The auditor could store audit analytical tools in the cloud and make them accessible to the general public and interested parties for improved disclosure and audit reporting (No and Vasarhelyi 2017). Cloud storage system has made data storage cheaper as businesses can now store and backup their information online rather than renting big floor area for document storage.

4.3.1.7.4 From competition to collaboration

This was unique point whereby, previously there were instance that clients "own internal accountant" could see outsources companies as competition or intimidation. With technology, both parties can now work jointly and amicably to resolve issues. At times, industrial survival depends on collaboration between rivals.

Participant **#10** explains that accountants are now able to collaborate with their partners due to improvement in technology.

"Industry 4.0 has brought in new business models in accounting like with us we are now technology implementing company as well… where we implements these migrations for clients who might have their own internal finance function or own internal accountant… which previously made it look as if we are competing with the people inside but now we are collaborating, where we are training them, working with people who initially it was either to insource or outsource but now the person who is insourced is now working with the outsourced person".

The research finding show that collaboration with other organisation has been facilitated by Industry 4.0 and created new business opportunities for accountants. Industry 4.0 has blurred the line between professions whereby accountants can now perform information and technology (IT) related tasks that were initial left to IT professionals. The finding is substantiated by Bez and

Chesbrough (2020) explain that collaboration with a competitor could increase organisations resources, boost productivity, attain legitimacy, and provide the two businesses an edge in the market. Some organisations might create formal collaborations that offer other clients administrative services like quality assurance tasks, proposal drafting, and staff training (Czakon and Czernek-Marszałek 2021). When organisations collaborate to provide services to the same group of clients, they can better meet the needs of those people in a number of different ways. Businesses may also work together by combining their resources, such as personnel and infrastructure to achieve economies of scale (Bez and Chesbrough 2020). Ccompeting organisations can interact on purpose to mitigate the harmful environmental effects of rivalry. The development of cooperative partnerships and resource sharing among organisations as a means of acquiring legitimacy may also be prompted by pressure from stakeholders.

4.3.1.7.5 Data processing

Clients are more involved in data processing aspect due to online apps and features. They can get instant reports on all transactions via email. The latest online packages allow for all sorts of financial statements, reports, and analytics to be available at the click of a button.

Participant **#2** explained that clients can now be involved in data processing due availability of different technologies that enables them to easily share information.

"In terms of opportunities definitely more clients being involved in data processing I mean you have apps and online systems that allow clients to take pictures of invoices and email us directly and the supporting app will load that information automatically and process it".

Participant **#3** is also of the view that the advent of Industry 4.0 has brought in different technologies that clients can use to share information with their accountants.

"…and we now also have WhatsApp that business use to share documents with other stakeholders, for example someone can just screengrab proof of payment on their phones and send it to you via WhatsApp whereby with the traditional

email you had to wait for some time for the bank to send the proof of payment. Industry 4.0 has accelerated remote engagement for example our smartphones can easily interact with the banks whereby you don't have to be in the office all the time for you to complete your transactions or do banking activities".

Participant **#8** shared the following opinion data processing

"The biggest benefit is that you have more time to connect with your clients and provide advice and financial insights as needed".

Participant **#11** suggests that with Industry 4.0 accountant can work from anywhere due to accessibility of the information online.

"There has been positive effect with the advent of the industrial revolution in terms of the preparation of accounting data or financial statement, this has been necessitated by services such as cloud services, office 365 or you can work from anywhere…let's say if you have issue and you cannot work from your office you actually have the opportunity to produce a set of financial statement from your house. we also have systems like mobile communication whereby on the go you are actually able to open up your set of financial statements or be it in a meeting with the stakeholders or even just collecting of information itself we can actually use WhatsApp for business which makes it very easy to Share reports and data across all platforms".

The study reveals that adoption of Industry 4.0 enables accountants to process, share and collect information instantly. Industry 4.0 makes it easy to process and share information with relevant stakeholders. The finding is aligned with Cagle *et al*. (2020) who opine that the capability of Internet of Things and Cyber-physical systems will enable automatic collection, interpretation, and analysis of data. In addition, Bhatnagar (2018) indicates that its beneficial for an organisation to adopt automated system because of the rising labour costs. The demand for workers will decrease because of highly automated operations. Automatic data collection will be made possible by intelligent systems and smart devices. Accounting software such as electronic resource planning (ERP) offers accountants a new and significantly more effective way to collect, process and share information (Cai 2021). Although robotic process automation (RPA) cannot eliminate all duties performed by individuals, but it will undoubtedly transform the

processes that require the involvement of human. Furthermore, businesses can share their financial records more quickly and effectively with relevant stakeholders through multiple channels like social media. Industry 4.0 offers multiple channels that organisations can adopt for information sharing.

4.3.1.8 Financial

Logically, the financial aspect has improved substantially though Industry 4.0. Financial modelling can now be done with both financially related, and unrelated data. Previously the focus was on related data, but now unrelated data can also be used which provide some insights.

4.3.1.8.1 Forecasting

Forecasting was much easier due to having online analytics and Artificial intelligence supported by regular capturing of financial data. Most needed variables were possible via technology systems. This meant that forecasting could be done regularly, accurately and had a fair degree of agility when it came to up-to-date reporting. Financial forecasting can prevent potential crises for businesses.

Participant **#4** believes that financial forecasting technology presented by Industry 4.0 helps them to accurately forecast the financial future and performance of the business.

"Financial forecasting now gives us more information from the data that we already have, so we can now go back five years to ten years and look at the assumptions that were made, like percentage increases, the quantity, the ratios we can now basically leverage data to get more understanding to assess forecasts or if we are preparing forecasts we can use that data to forecast information better. We can now identify relationships automatically that we may not have thought of before… so for example like we normally look at revenue and cost of sales…like if cost of sales increase the revenue must increase and so forth but maybe there's revenue to rent as your rent increases your output increases as well… so those relationships can be identified automatically… so when you're forecasting you can forecast for rent as well as revenue not just cost of sales and it helps you identify those relationships better".

Participant **#5** explained that Industry 4.0 technologies enables them to include all the variables rather than the previous systems that could only allow for one or two variables.

"For forecasting normally you would have done your forecasting on one or two variables and then you have to sort of make some assumptions or you have to hold that variable constant and try and focus on one, if the shift in this what happens… if the shift in that what happens… but now with Industry 4.0 and more specifically artificial intelligence you can throw in all your variables at once and you can do a full casting you don't have to now make assumptions. You can basically throw in everything and see how everything affects each other and with more development on that artificial intelligence they keep on learning as well based on whatever information they have and then the nice thing also is with Industry 4.0 having all the information on the correct version".

Participant **#11** had similar views on how Industry 4.0 is influencing financial forecasting

"In terms of financial forecasting the Industrial 4.0 has brought about systems like AI artificial intelligence… with the accounting system that I use myself there is an inbuilt intelligence and machine learning capability. When you are doing repetitive tasks like data capturing and allocation if you programme it very well which means every month you can run a set of financials with the click of the button because the system continues to learn from the way you keep allocating transaction from this month to another month…then when you come to login you see that everything is already been coded all you need to do now is going to the system and correct a few items and check because it's not going to be 100 percent correct. But you can now save on time that you could use to do another really demanding task".

Participant **#12** suggests than Industry 4.0 technologies have improved financial and risk analysis.

"On financial forecasting and risk analysis the technology does come in handy. Imagine traditionally when you had to focus for a period of five years into the future and you had to actually have these data thrown up onto excel imagine how big the excel spreadsheet would be and how much skill it will require you to

actually have this data so that you can have five year projection… and you'll need the data to populate into the income statement, into the balance sheet and the cash flow of the company… but now because of the industrial revolution there are companies that are coming up with these forecasting software and all you need to do is to just feed in a few set of assumptions on an assumption page and just put your data on one spreadsheet and then the system using an algorithm pre populate all this data into the income statement for five years".

The above statements indicate that Industry 4.0 has a significant influence on financial forecasting. Traditional techniques of financial furcating may be ineffective considering the volume of data flowing from Industry 4.0. The data come from a variety of sources, some of which are internal to the organisation while others are external. Huttunen *et al*. (2019) explain that predictive analytics are important for making accurate forecasts from the available data. Big data forecasting is now constrained by the fact that conventional methods are unable to handle the volume, velocity, and variety of data, which presents difficulties for businesses. Machine learning is a suitable choice for financial forecasting and planning due to its ability to retrieve insights from massive amounts of data in a completely automated manner (Wasserbacher, and Spindler 2021). Accurate financial forecasting is important in circumstances where market conditions are turbulent or constantly changing (Möller, Schäffer and Verbeeten 2020). The primary objective of financial forecasting is to aid management in decision making. The decision-making process is guided by a combination of instinct and analysis. Companies are rethinking their approach to forecasting in consideration of the desire to migrate to "nowcasting," an automated method that can forecast future performance (Arnaboldi, Busco and Cuganesan 2017). Accurate financial forecasting of bankruptcy in an efficient way and preventing default may permit the implementation of measures to improve organisations' financial health.

4.3.1.8.2 Cost saving

Costs are saved in numerous ways. Automated costs were much lesser than manual costs. This manual cost entailed labour costs to capture data, process data and prepare various statements. Automated systems did all of these and more at minimal cost.

Participant **#2** shared the following views regarding the cost saving brought by Industry 4.0.

"Bank feeds now automatically load the business transactions every day versus you manually sitting and capturing and labour cost effective… human that would be involved in that process that sort of eliminates the need for them. But we would still need some human interaction behind the technology because as much as the technology is smart you still need someone with a particular knowledge and background to do the final checks and do authorisation just to make sure that there's risk involved is 100 percent".

The view below is shared by participant **#3** who indicates that firms can save on labour and storage cost due to automation and online storage applications.

"…and there is an element of savings when it comes to the Industry 4.0 in terms of labour because there will be reduced labour employed on data capturing, cost of storage and other related items… but there is also another social costs that some other people are likely to lose their jobs if they are not moved into other departments".

The study finding shows that automation decreases labour cost as there would be no need to employ humans in tasks that can be done by technology. The study finding is aligned with study by Moffitt, Rozario and Vasarhelyi (2018) who maintain that robotic process automation robots carry out tasks through the software presentation layer in a manner similar to that of humans. Businesses can automate repetitive and labour-intensive tasks like data capturing. Considering the advancement of technology, many workers could lose their jobs as result of automation. Chatbots and Personal Virtual Assistants are continually developing and are now incorporated with backup systems (Searle 2018). In addition, virtual assistants and Chabot are transforming the financial industry's customer service by communicating with clients or users in the language they understand across social media platforms (Burns and Igou 2019). Similarly, call centres are increasingly transforming and chatbots are replacing individuals (Lai, Leu and Lin 2018). Therefore, the introduction of innovative technology will lead to less waste and consequently lower operating expenses.

4.3.1.8.3 Tax returns

Tax returns can be seamlessly done due to SARS e-filing. This alleviates significance effort, cost, and stress of having to file tax return manually.

Participant **#13** shared the following views regarding the influence of Industry 4.0 on submission of tax returns.

"For tax returns there are different sections of the income tax that you need understand and you need someone with that knowledge… but now what South African Revenue Service (SARS) has done is bring that knowledgeable person in to your fingertips through e-filing app and that e-filing app becomes that person that would normally be a consulted and they just guide you step by step. If you follow that e-filing process it's exactly what an expert would do for you… all you need is to follow each step and input the correct information that is needed and you will be sorted, but previously even if you had that information and you had to find the person to do it for you because you don't have the knowledge but now SARS e-filing system becomes that knowledge for you".

Similarly participant **#12** shared the views below.

"In terms of tax return preparation the industrial revolution has gone a long way in assisting practitioners… previously we would sit down with a client with a record form and ask them questions, then analyse the information before you, put it up on return and sometimes we end up with information that you don't actually require… but with these new technology you have these system designed for you specifically for the filing of that income tax return. So, you have the exact questions that you need to ask client so all you have to do is ask the client this question and fill in that assumption page and then the income tax return populates automatically on this system so this returns that we now preparing are very accurate".

The finding revel that adopting of Industry 4.0 in tax administration will significantly reduce tax compliance costs. Nazarov, Mikhaleva and Chernousova (2019) show that the implementation of cutting-edge technologies in revenue collection enables the provision of real-time tax administration. In addition, adopting advanced technology in tax administration will reduced the time required to submit tax return thereby improving the tax compliance behaviour of taxpayers. A study by Nomlala and Oluka (2021) revealed that taxpayers spent

a lot of time traveling to the tax office to file their tax returns. Implementation of modern technologies in tax administration lower administrative costs of collecting revenue.

4.3.1.8.4 Competitive costing

Accounting services can now be more affordable to clients due to increased efficiency and time saving aspect of online systems.

4.3.1.9 Real time information

The aspect of real-time information is a key enabler of Industry 4.0. Real-time information allows for proactive preparation of financial transactions using real-time and updated information. This means financial statements and other related documents can be based on current and factual data rather than historical data. This enhances the accuracy and relevance of financial reporting. Capturing real-time data could save time as opposed to going manually searching for hard copies and historical data. Furthermore, missing data can be easily found due to data being in real-time. Information sharing becomes easier and more efficient, thereby saving time in information dissemination.

Participant **#2** had the following to say on real-time information brought by Industry 4.0

"Technology also allows for increased output because of faster preparation of financial statements, preparation of tax returns and provisional returns as well as your notices to clients".

Participant **#5** explained that data capturing, and preparation of financial reports has been made easy due to availability of information in real time.

"The preparation of accounts become so easy that if you have your accounting system set up and when you capture that information it means that you already have all your accounts prepared… that's to say you already have all the financial position and financial performance that you can get just making sure that the information is inputted correctly and then with just click of button you can get all the information you need".

Participant **#6** shares the view that accountant no longer depend on historical information because business transactions are captured in real time.

"Industry 4.0 has brought a lot of changes in accounting for example traditionally accounting was practice that depended on historical information but now with this new technology accountants can prepare financial statements with updated information; this information can be collected in real time that's why accountants are now called Real time accountants because they can prepare financial statements in real time but also the information now is readily available from different platforms".

Participant **#11** had similar views with other participants.

"The preparation of accounts and tax returns has actually changed for example, now you can create a set of financials in five minutes given the advent of software like Craftwork which is cloud best software… all you have to do is login and upload your trial balance there and in five minutes you can have your set of financials which did not happen in the past as you would need a lot of authorisation from departmental heads and other personnel whereby most of those tasks now have been automated with artificial intelligence and machine learning which actually can automate those repetitive regular tasks and the accuracy rates has actually increase probably to 96 or 97 percent accuracy because it depends on the information that you input in the system. Artificial intelligence and machine learning has contributed to that because the keep learning on how you do things".

The finding indicate that real-time information allows for proactive preparation of financial transactions using real-time and updated information. The availability of information immediately after the transaction is processed is expected to increase with the adoption of Industry 4.0 in accounting. Accountant would be able to collect and process transaction as they happen, and management can make an informed decision immediately. The time taken to collect and process this information would be reduced with the adoption of robotic process automation and artificial intelligence technologies. The finding is supported by Altuk and Kablan (2020) who found that the adoption of accounting practises that are in line with Industry 4.0 will lead to a reduction in fraud, process time and

errors which will result in the preparation of better financial statements. Therefore, accountant would be able to correct any errors and investigate any potential fraud immediately. Furthermore, Schekoldin, Bogatyreva and Ilyukhina (2019) indicate that due to large amount of data flowing from Industry 4.0, employees could save time by moving a sizable portion of calculations to be performed by computerised program. This decreases the number of errors which decreases the time required to make corrections on results. The information gathered will have meaning and value if it is accurate. Moreover, audit analytics could be further facilitated by blockchains' potential to provide data in near real-time.

4.3.1.9.1 Cloud accounting

Cloud storage and access allows for almost unlimited storage capacity but also for instance access of real-time information to stakeholders. One of the most practical and effective ways to save data online is through cloud storage.

Participant MI shared the following views regarding cloud accounting.

“Cloud accounting software is a powerful tool for enhancing customer relationships and accessing your company's financial information in real time”.

Participant **#10** explains that efficiency in report compilation has been improve by cloud-based accounting systems.

“The cloud software that we are using for uploading the document is able now to extract the data from the invoice, the key dates, the VAT number, supply information without you having to capture. It's able to extract the information directly from the information that was uploaded by the clients and from there you just approving those that has been extracted. So, that has now made the services that we undertaking to be efficient in terms of compiling reports because now the information is uploaded directly onto that platform. We are also using the document management software where you can have access to client’s information at any time… we are seeing now that there isn't a need for you to maintain paper-based documentation because now the information is stored on cloud”.

The study reveals that advent of Industry 4.0 is transforming tradition accounting desktop packages into online applications. Cloud based accounting applications enables accounting professional to have access to the software at any time and be able to work from anywhere without the need of traditional office setting. Therefore, accountants will not need traditional accounting departments because of cloud-based software. This new office structure will offer significant cost-cutting benefits for accountants and businesses (Yürekli and Şahiner 2017). The study finding is further supported by Kablan (2020) who found that traditional accounting software would evolve into real-time accounting apps with the emergence of Industry 4.0. Cloud-based accounting applications will facilitate remote access to the software, real-time information processing, automatic data capturing and instant information sharing. Accounting in the cloud domain will allow management and other interested individuals to have constant updates on the status of companies' operational activities. This way, professionals will be able to give daily or weekly updates to the management while work is in progress rather than once-off upon completion.

4.3.1.9.2 Decision-making and ease of information

Real-time information allows for proper and effective decision-making that is based on accurate and up-to-date information. Furthermore, information is easily searchable instead of manually searching for paper-based information which can cause delays in processes and decision-making.

Participant **#3** shared his experience on how Industry 4.0 is influencing decision making.

“All the interested stakeholders can now have the information in real time that saves time, so there is no need to have historical information because they're going to have the information that they need for decision making at the right time… and also this information can be shared with other departments and there would be no delays in the decision making by management because the information is gathered in real time which is a huge benefit of the Industry 4.0”.

Participant **#10** shared similar sentiments with **#3**

“Access to the information has been made easy and you can do an audit on that information because information is electronic format… you can easily search rather than just going to the client’s premises and navigating through files which takes a lot of time. The document management software makes it easy for you to search and manage information easily”.

Real-time information enables accurate and timely decision-making. Moreover, better processing power and storage capacity make it possible for accountant to collect and keep track of information. Departments can collaborate more effectively because of real-time access to information. With more information at hand, management are able to make more informed decisions leading to higher levels of reliability and consistency in output (Apostolopoulos 2018; Ferreira 2017). Blockchain technology enables virtually real-time accounting reconciliation and transaction records (Liu, Wu and Xu 2019). Management processes in organisations are changing because of the increased availability of digital information and technologies. Accounting professionals' perspectives on information gathering, sharing, and decision-making are projected to undergo notable change as a result of digitalisation.

4.3.1.10 Increased output

Output has increased due to Industry 4.0 technologies.

4.3.1.10.1 Increased automation

The increase in automation holistically brought increased efficiency, time-saving, cost saving, real-time information and storage which inevitably led to increased output. Society and accounting clients will benefit from the implementation of Industry 4.0 in accountancy.

The views below are shared by participant **#1** who explains that Industry 4.0 has transformed the way accountant are executing their tasks.

“The emergence of Industry 4.0 basically kind of made the way we do our work as accountants’ difference in the sense there is an increase in automation of some tasks… everything nowadays is now basically computerised, and the way work is now being done is quickly and fast”.

The views below are shared by participant **#2** who thinks that Industry 4.0 has accelerated digital transformation in accounting.

"Of course, before my time because like I said I'm fairly young, I would assume that processes were more manual so with the release of smarter, more efficient and cost-effective top technology being cloud based and automated systems that's definitely allowed accountants to focus more on the end goal versus the in between of your day-to-day business".

The views below are shared by participant **#5** who thinks that Industry 4.0 is transforming accounting from previous manual to automated systems.

"I think for me Industry 4.0 is influencing accounting through automation settings processing where things used to be done manually but now, they are being automated. For example, you no longer see jobs for data captures being advertised but now you see more jobs for data analyst".

Participant **#7** shared the following views.

"In terms of technology in general a lot of industries have been changing and that includes accounting sector and for us it has made us to focus more on investing in information technology (IT) as well as investing in systems to make sure that we keep up with what is required in the industry, and we don't fall behind".

Participant **#8** elaborates that accounting profession is moving away from manual system to more automated systems.

"Industry 4.0 has significantly affected accounting profession, for example, accounting software packages provide reporting options, create financial statements, and use of robotic process automation to keep repetitive records more efficiently and accurately".

The finding reveals that the adoption of Industry 4.0 in accounting increases efficiency in the compilation of financial statements. This finding corroborates with Vrbka and Rowland (2019) who assert that businesses are using robotic process automation along with artificial intelligence capabilities to boost performance and productivity. Therefore, the time spent compiling statements and cost of producing financial statements will ultimately decrease due to

implementation of automated systems in accounting. The influence of Industry 4.0 on cost of compiling financial statement might be insignificant than its impact on the quality of financial reports brings in accounting. Most accountants no longer have to spend a lot of time processing repetitive transactions because of automation systems. This is because robotic process automation allows machines to do tasks that are often done by people. Robotic process automation (RPA) program automates business processes by imitating human activities when using digital technologies to execute tasks like processing or transferring data. The finding is further supported by Ng and Alarcon (2020) who explain that businesses may boost production and efficiency while spending less money by utilising RPA.

4.3.1.10.2 Faster

The increase in speed allows for the accounting firms to be able to thrive in a fast-paced environment. This has also led to the decrease in time taken to perform tasks.

Participant **#1** indicates that Industry 4.0 has make the work of accountants much quicker and easier.

"It has made work much easier and much quicker, and we live now in the fast-paced environment where things are changing quickly and you need to catch up and do things in the fast way… almost everything is now basically computerised so those are some of the things that I can relate to you as to the changes that have been brought about within the accounting framework".

The study finding show that the speed of data processing has improved and reduced the time accountants spend on preparing financial reports. Ng and Alarcon (2020) support the study finding, they explain that when an employee commits an error, machine learning can continually learn from it and consider that error when processing subsequent transactions. As a result, machine learning may greatly enhance account reconciliation and could save businesses many hours of human processing time (Bowling and Meyer 2019). Additionally, machine learning is capable of identifying and prioritising matching transactions that accountants may want to further examine. As a result, businesses must digitise their processes to remain relevant in the age of Industry

4.0. Furthermore, artificial intelligence gives managers a lot of information that helps them make better decisions (Dwivedi *et al*. 2021). Consequently, as high-powered computer systems and related software become more accessible, accountants have embraced some of these systems to improve the quality of financial reports they produce for their clients.

4.3.1.10.3 More clients and other tasks

It also allowed for more tasked to be accomplished and the extra time can also be used to source more clients and enhance productivity.

Participant **#5** shared the following views.

"But now with Industry 4.0 you don't even need to go to the client's premises…we can get all the information we need in real time so that's basically reduces the amount of time spent on gathering information which frees more time on accountants to maybe to look for more clients or to do other work for the client that may necessarily have been done in that time".

Participant **#8** explained that.

"With regards to auditing, the new technologies are reducing the number of repetitive tasks that employees perform. This means that they will be able to spend more time on other valuable tasks and interacting with customers. Accountants are learning to use new software and other technologies, rather than manually handling traditional accounting and audit tasks. For example, the Cloud-based accounting systems enable accountants to access and edit files from anywhere".

The study reveals that introduction of Industry 4.0 has profoundly transformed the way accountants perform their duties. Accountants can take on more tasks because of the automation capablities of Industry 4.0 in accounting. The is aligned with the study by Knudsen (2020) who found that accountants may continue to have a place in businesses, but digital transformation will seriously undermine certain responsibilities they perform. The use of artificial intelligence to automate the bank reconciliation function lessens time and increase efficiency for financial statements. Advanced software like artificial Intelligence and robotic process automation enables accountants to automate some repetitive and

laborious tasks that consumed a lot of time for example data capturing and reconciliation. Therefore, accountants free more time to do more ad hoc tasks that cannot be automated. Awang *et al*. (2022) indicate that digitalisation may affect accounting profession in a significant way, but it also has the potential to expand accounting duties, how they are done and by who. While robotic process automation may not eliminate work entirely, it will undoubtedly alter the kinds of work that require human intervention (Arnaboldi, Busco and Cuganesan 2017).

4.3.1.11 Skills and development

Industry 4.0 allowed accountants to become multi-skilled.

4.3.1.11.1 Multi-skills

Accountants are now able to be well-versed in technology. Hence digital literacy becomes a core component and competency of accountants. Regular upskilling is always needed in Industry 4.0.

Participant **#6** believes that Industry 4.0 has blurred the lines between different profession.

"…from number crunching to system analyst which was previously left for IT specialist but at the same time we are also seeing people who do not have any background in accounting are now performing accounting duties because of these new technologies… you have seen engineers being employed in the accounting firms".

Participant **#7** points out that new skills and upskilling will be needed to meet the skills demanded by Industry 4.0.

"Industry 4.0 has made us to realise that there are some skills that will be replaceable in the future and there are things that would not require human intervention… where you can automate these tasks which means that some skills might become outdated in the future so we as accountants also need to realise that we need to upskill ourselves so that we remain relevant or be part of the Industry 4.0".

Participant **#8** explained that.

“The skills associated with blockchain technology are also relevant to the digital literacy needed for future accountants. For example, the use of new payment systems and cryptocurrencies is irreparably changing traditional money concepts, exchange methods, and existing business models”.

The study shows that the emergence of Industry 4.0 has influenced the need for accountants to acquire new skills to succeed in the new era. The finding is aligned with Al-Htaybat and von Alberti-Alhtaybat (2017) who show that accounting professionals acknowledge that the capabilities of data analytics are valuable for decision-making, but they require extra skills to apply data analytics effectively in the workplace. The finding is further supported by Barinova, Sheremetyeva and Zotova (2019) who explain that new skills that are going to help businesses through digital transformation are developing as the old ones fade into history. The modern accounting professionals must also consider how to analyse a large quantity of unstructured data, which must be recorded in the financial statements for useful decision-making. Therefore, old auditing approach may no longer be adequate due to the exponential growth in volume of data, data speed, data diversity, and the rapid development of associated technology (Appelbaum *et al*. 2017; Badertscher *et al*. 2017). The ability to support decision makers in the implementation and administration of information systems is a talent that an accounting professional ought to have. One of the most important talents in today's information-rich culture is the capacity to gather, organise, and analyse data using computer. Given the increasing implementation of Industry 4.0 technologies in the workplace, digital skills requirement will only grow in significance in the years to come. Therefore, professionals in the era of Industry 4.0 require not just the ability to work, but also the desire to learn new skills on the job.

4.3.1.11.2 Structure and scope

The structure and scope of the accounting curriculum was also being updated to introduce technology into it.

Participant **#8** believes that Industry 4.0 is changing structure and scope of accounting.

"Industry 4.0 is changing the structure and scope of accountant skills by imposing new and challenging demands on accountant skills. Many professional accountants, such as the Association of Chartered Certified Accountants (ACCA), the Association of Chartered Certified Accountants (ICAEW), and the Certified Global Management Accountants (CGMA), have already begun to change the content of the accounting curriculum, introducing Information Technology and Data Analysis as part of education and training".

The study found that it is crucial to revise accounting curriculum to make sure young accountants have the right abilities. Accounting students should have a solid background in information and communication technology. Accounting programmes must incorporate software packages in accounting subjects to cope with this demand and support students in becoming prepared for the job market (Sledgianowski, Gomaa and Tan 2017). In addition, Sledgianowski, Gomaa and Tan (2017) found that the implementation of integrated information technology in curriculum is quite low. Accounting learners need to learn data analytics for processing large amounts of big data, as well as the essentials of information security to keep up with the times as the industry continues its inevitable migration to digitalisation.

Accounting was traditionally viewed as a profession that primarily focused on tracking the financial performance of businesses. However, disclosures about the effects of climate change are becoming increasingly obligatory in the accounting industry. Consequently, the scope of accounting is significantly expanding to incorporate reporting on the impact of business activity on society and the environment. Financial reporting must incorporate social and environmental concerns (Gulluscio *et al*. 2020). It is because a business should not only disclose their monetary activities but also their ecological and social impacts.

4.3.1.12 Space

Space in terms of storage space was greatly influenced for the better.

4.3.1.12.1 Storage

Storage was now almost unlimited due to Cloud technology. This meant that digital documents and data could be stored in real-time on the cloud. There was no need for large storage rooms and facilities. Cloud storage also meant instant back up and retrieval when needed. Drag and drop are user-friendly feature for uploading documents to cloud services. The benefits of using cloud storage can result in significant cost reductions.

Participant **#3** indicates that the availability of online storage makes it possible to backup company's information on cloud.

"What I can see here it's only document storage and financial forecasting with documents storage there is no need now to have big files or storerooms or cost related to document storage because the company data can be stored on a small USB or it can be stored in cloud that is if you are using an online a package or you can also do an online backup for all your records… so in terms of storage there is a reduction of storage costs".

Participant **#4** point out that cloud storage facilitates electronic storage of accounting information.

"So, because of the use of electronic documents a lot of the document storage has moved to the cloud as opposed to physical warehouses like document manager and metro file. The storage has gone to cloud services for people to store things online".

Participant **#5** shared similar views with other participants.

"For storage I think the cloud is given the way currently everyone is storing the information on the cloud which makes it possible for people to receive the data or have access to their data at any point in time from anywhere… you don't have to be restricted by the information being somewhere or it's sitting in a server somewhere or the backup is somewhere yeah you still have some backups but now being in the cloud you can access it at any place and at any time… but also the clients no longer have to buy storage equipment that is large enough to hold the data so they just need to pay for the service of someone else who's holding that data and having that acquisition costs on their side… this storage technology is improving… now you can store a lot of data in simple devices".

Participant **#7** highlights that cloud storage allows documents to be stored online which makes it cheaper and more convenient for accountants to access information.

"With data storage I would say it has influenced it in a way that now we've online backup and use a cloud accounting system. Cloud was something that not many people used because it was mainly servers where there was server in the office and off site for backup right now people are moving towards cloud-based storage which is more convenient and cheaper".

Participant **#8** explains that.

"With the use of Cloud accounting software, you can optimise your data storage. Cloud accounting provides with many opportunities to extend the services offered and realise the efficiency and additional benefits".

Participant **#9** indicates that cloud storage improves the safe custody of company's information in case fire or any natural disaster.

"When the building was on fire I was stressed out because we were are all going to lose all data… but thanks to the cloud technology because we get to scan documents and then we save them in the iClouds (online storage like one drive) so we were able to retrieve whatever that we want to retrieve and also we can work anywhere at any time like during lockdown we were working from home and able to collaborate with each other because the document were saved in the cloud".

Participant **#10** held the following opinion

"Even in terms of our offices you can operate now in a very small office but be able to deliver turnovers that are high as if you have a big office because now you don't need to have big filing rooms as everything is stored on cloud and most work is done remotely so I think that's what I've seen through the emergence of these technologies in the accounting profession".

Data sharing capabilities are offered by cloud storage services enabling users to exchange files with multiple stakeholders in real time. This feature helps accountants to work on the same file concurrently thereby boosting productivity.

The finding is corroborated by Turner, Weickgenannt and Copeland (2017) who found that users have the option of inviting others to examine the document or sending a file to another user. The business lowers the costs of storage by adopting online information storage. Cloud storage costs are quite cheap, and storage adjustments are simple. The bulk of the firm's data management requirements are fulfilled by the cloud service provider. Additionally, the cloud service provider handles data protection and backups. Once uploaded to the cloud, data is available from anywhere, across any device. This provides great flexibility for both analysts and users within the firm.

4.3.1.12.2 Paperless

Paperless working was finally possible as manual files were no longer needed. Digital documents entailed faster capturing, storage, sharing and environment friendly.

Participant **#2** explains that accountants are moving away from paper-based documents to electronic format.

“Also, paperless accounting I don't know if you've heard of that term but it's something that is within the industry where people are trying to move away from manual files archiving to paperless and everything will be cloud based which allows you to store information in the cloud”.

Participant **#7** held similar views with other participants.

“We still sort of have a manual archive process as you can see there's a few files on my desk so as much as we haven't fully moved over to the paperless online system, we do keep manual files, a financial file, tax file and legal files just to have some sort of paperwork or paper trail for working papers”.

Participant **#8** points out that the advent of Industry 4.0 has changed the way accountants are sharing information.

“Technology has also changed the way we share information between ourselves and our clients for auditing and accounting purposes, enabling the use of digital signatures, thereby supporting the quest for paper lessness”.

The finding of the study reveals that Industry 4.0 is influencing accountants to adopt paperless transactions. Adoption of paperless transactions helps the business to save on printing costs but improves efficiency due to online storage. If implemented, a paperless firm idea would help minimise the paper used in the workplace. Accounting sector has been known to be among the biggest users of paper. The finding is corroborated by Šuleř and Machová (2019) who opine that the idea is mostly realised by converting paper documents into electronic formats, which are effective, economical, and can significantly save operating costs. Moreover, companies may be forced to adopt paperless transactions due to increased pressure from the younger generation who prefer the flexibility of digital services. Conventionally, a wide range of businesses worldwide use paper every day to disseminate reports at the office and to other stakeholders. Conversely, due to the wide range of text size, records occasionally lose ink, and cannot be accessed by some employees. Another innovative method of sharing information is electronic documentation. By implementing the paperless idea into practise, the business may reduce its printing expenses. Some businesses are leveraging digital systems to transition from paper-based documentation to electronic documents (Mwende and Kasamani 2018). Globally, many firms now see that adopting Industry 4.0 as an essential strategy for their long-term success. Although not a novel concept but the paperless idea is continually evolving.

4.3.2 Sub-theme 2: Primary Industry 4.0 factors influencing accountants to adopt new technology.

Relating to the above, this primary subtheme outlined the key Industry 4.0 factors influencing accountants to adopt new technology.

4.3.2.1 Environmental

The overall business environmental factors were the highest determinants of technology adoption. This is informed by the following.

4.3.2.1.1 Competition

Competition was the largest determining factor whereby if one did not keep up to technology, they would become irrelevant and outdated and eventually perish.

The key difference between Industry 4.0 and earlier revolutions is the use of sensors to collect data during operations.

a) Competitive environment

Holistically, the environment was competitive and if one did not keep up to latest trends and technology, then they could not survive. Businesses are encouraged to implement Industry 4.0 to enhance their company productivity and financial performance due to the extremely changing economic climate and growing competition. With the advent of Industry 4.0, it is anticipated that companies will be able to produce more by coordinating the efforts of employees, robots, and computerised systems.

Participant **#1** shared the following views on how the environment in which accountants operate is influencing the adoption of Industry 4.0.

"If you look at the competitive environment that is the biggest factor because you can't be running on paper while your competitors are running on new technology therefore, they will always be ahead of you, and you may not survive right so that's just the biggest factor".

Participant **#13** elaborated on how stakeholders influence accounting firms to implement Industry 4.0, especially the pressure from government institutions and trading partners.

"For example, SARS will require you to install an e-filling application if you have to capture and process more than 50 employees' IRP5 certificates. The current business environment is so competitive and implementing these technologies will keep you in the business because if you don't your competitors will take a bigger share of the market, imagine what happened with lockdown businesses that had the ability to trade online were less affected".

The study finding indicate that accountants are influenced to adopt Industry 4.0 because of the competitive environment in which they operate. Implementing cutting-edge technologies will aid businesses in overcoming the intense competition inherent in many sectors. Al-Hujran *et al*. (2018) reveal that pressure from competitors can influence firms to implement new and innovative technologies to enhance their operations and achieve a strategic advantage.

Senior management's willingness to implement Industry 4.0 may be motivated by competitive pressure. Competitive pressures may be caused by the industry's constant technological developments or by rising security issues. Lin *et al*. (2018) assert that adoption rates of new technologies tend to increase in response to intensified competition. Likewise, when businesses are under pressure, they tend to adapt their strategies to fit current practices that have been established by the industry leaders (Awa *et al*. 2017).

Competitive pressure frequently induces retaliatory behaviour, creating an ongoing vicious cycle (Awa, Baridam and Nwibere 2015; Awa, Ukoha and Emecheta 2015). Mimetic pressure forces an organisation to modify its business strategies in order to align them with those of the sector's leaders, particularly those it considers successful. Mimetic pressure develops when businesses realise that implementing Industry 4.0 will help them improve operational performance and control. Businesses' profit margins improve when they adapt to mimetic pressures because they become more competitive.

b) Clients

Clients can end up moving to competitors if competitors are able to offer them what you cannot. It is important not to be overtaken by competitors in service offerings and technology currently played a key role in service offerings.

Participant **#4** explained how clients could influence accountants to adopt modern and innovative technologies presented by Industry 4.0.

"the primary factors will definitely be a value added to clients… so clients now know about it… they want it as well and they want to know what you are doing, how you are doing, how you can help them and if you don't do it… another person is going to approach them and offer those services to them".

Participant **#8** elaborated that the pressure to offer customers better services does influence accountants to adopt Industry 4.0.

"There are various reasons that are influencing the accounting profession to adopt new and innovative technology presented by Industry 4.0, and they include competition. If accounting firms realise that their counterparts or competitors have improved efficiency due to the use of new technologies, they are compelled

to adopt the Industry 4.0 in order to remain relevant in the market and to serve customers better".

The study found that customer pressure can influence accountants to adopt Industry 4.0. Pressure from clients within a given market may force businesses to mimic the practices used by market leaders and cause them to resemble one another. The finding is corroborated by Molinillo and Japutra (2017), who found that the decision to use modern technology is affected by the normative pressure that comes from customers and suppliers. Using technology to streamline administrative tasks can afford businesses a competitive benefit. Moreover, pressure from clients puts companies under intense pressure to implement Industry 4.0 to stay in business.

The study is further aligned with institutional theory that explains that normative pressure has a significant influence on technology adoption by firms (DiMaggio 1988). From the theoretical lens, normative pressures in the accounting environment relate to the pressures exerted by clients and suppliers on accounting firms to adopt Industry 4.0. The organisation would be attempting to lessen competition while attempting to strengthen its market domination. Businesses can follow in the footsteps of some successful industry leaders in the era of Industry 4.0 by observing what they do and paying attention to what they have to say about the advantages of adopting Industry 4.0.

c) Opportunities

Technology can provide new business opportunities. If these opportunities are not seized, then competitors will end up seizing them and progressing.

Participant **#9** shared his experience on some of the business opportunities presented by Industry 4.0 in accounting.

"When you adopt some of these technologies, they should bring an added advantage over your competitors for example improvement on customer care and increase your business opportunities".

Participant **#10** had the following views regarding business opportunities that a firm may reap after implementing Industry 4.0.

“Obviously as I have said you know one of the main one is that competition now is higher because you can't just rely on being regional accountant…I mean accountants based in Durban can service or operate from anywhere. So, you can't just say I'm just going to open set-up an office in Durban or in a specific location then I'll be the only one… competition is higher but obviously that's an opportunity because if you can position yourself online as an accountant you can be the significant player where you can service clients all over like how we are doing it. We being a small firm it's a very competitive space so you need to have competitive advantage over your competitors therefore adopting some of industry technology may give you competitive edge because you want to have a competitive edge in the market place”.

The study finding show that gaining a competitive advantage in the marketplace influences accountants to adopt Industry 4.0. Businesses must create innovative approaches to acquire an edge over competitors and maintain their competitiveness in the industry. Modern technologies have emerged as key drivers of global competitive advantage. The finding aligns with Gürkan and Çiftci (2020) who state that the goal of digitalisation is to gain a competitive advantage through the strategic use of information and communications technologies. Companies that invest in advanced technology to improve their customer service experience will have an advantage over their competitors. Therefore, accountants who adopt Industry 4.0 will have a competitive advantage in the marketplace. A competitive advantage can be gained by automating back-office operations in an accounting firm. Customers are more likely to stay with a business that works effectively and does not make mistakes. Consequently, the advent of Industry 4.0 accounting firms will carry out transactions faster and cost effectively as possible. Businesses that can quickly adopt and implement new ideas will have a competitive advantage over their rivals. Vadlamudi (2021) indicates that the Internet of Things makes it possible to create economic benefit which gives businesses a competitive advantage in the environment they operate. An organisation may only adopt an innovation, a new product, or a new service if they believe it is a better alternative than the one currently in use (Wani and Ali 2015). Technological innovation has the potential to drastically lower expenses and increase operational efficiency.

4.3.2.1.2 Relevance and up to date

It was important to stay up-to-date and relevant in the current epoch. Technology allows firms to stay current and relevant. Clients, suppliers, competitors, and all related stakeholders who were adopting technology would eventually require a firm to adopt similar technology to keep abreast.

Participant **#3** elaborated on the need for accountants to keep up to date with the latest technologies to stay relevant in the industry.

"You see the world is changing every day so if you don't adapt to the new technology you risk being left behind… let's take for instance Windows 7 operating system is no longer supported by Microsoft so if you don't move with time you may risk having your software not being supported or being unable to get security updates… and also remember that banks now can link your bank account with your accounting package so that all your transactions can be directly downloaded to your system… so if you are using old systems the bank will tell you that your system is not compatible and you will be required to upgrade, so sometimes you need to move with time".

Participant **#5** explained that accountants are motivated to adopt Industry 4.0 technology to eliminate the issues of compatibility with their trading partners.

"If everyone is adopting Industry 4.0 like your clients, suppliers and other stakeholders so if you don't you sort of make it difficult for them to deal or do business with you it's at that stage now you feel that if you are not going to join you will miss out so this kind of influence and pressure is likely push one to implement Industry 4.0 because it's what your clients, suppliers and other stakeholders want".

Participant **#6** also shared similar views on the need for accountants to adopt modern technology to stay abreast of new business practices.

"Accountants may be influenced to adopt new technologies or Industry 4.0 because of the environment in which they operate... you may find that their business partners are using the latest technologies which compels them as well to adopt new technologies for example, most businesses now are adopting business WhatsApp for communication and sharing of documents… but then you

find that you are still sticking with SMS that doesn't allow you to share large documents".

Participant **#8** highlighted the need for accountants to implement new and innovative technologies to meet the needs of their clients.

"In addition, the new generation of today are digitally savvy, and because of their experience from other service providers, they expect the financial sector to also provide digital services which are more convenient, fast and less time consuming".

Participant **#9** explained that accountants are influenced to adopt Industry 4.0 in fear of their systems not receiving updated security patches.

"Sometimes you don't want to be left behind, so you end up following the industry leaders because if the system you are using becomes obsolete then it becomes vulnerable to cyber-attacks as your system may not be supported anymore by the service provider for security updates".

The study reveals that the need to stay relevant and up to date influenced accountants to adopt Industry 4.0. This may come from customers' and suppliers' pressure for accounting firms to adopt Industry 4.0 for conformity. The study finding is supported by Meyer *et al*. (2018) who explain that to secure continued support, deliberate efforts are undertaken to establish, retain, and maintain legitimacy in the eyes of external forces. Businesses that choose not to implement Industry 4.0 may feel pressured to conform to the standards of their industry's leaders or risk falling behind. This could even influence those who have been slow to embrace Industry 4.0 to become pioneers in their discipline (Obal 2017). In most industries, the first users of modern technology have a competitive advantage. Other businesses may also be thinking about implementing Industry 4.0 to sway customers in a competitive environment (Ingaldi and Ulewicz 2019). Innovations with a clear, distinctive advantage in terms of strategic effectiveness and operational efficiency have a higher likelihood of being adopted (Greenhalgh *et al*. 2004). For example, an innovation that is perceived to boost efficiency has the highest chance of adoption and implementation. As a result, the more advantageous an innovation is, the faster it will spread in a social system. When

confronted with an intense rivalry, companies often attempt to implement modern technology to gain a competitive advantage.

4.3.2.1.3 Legal

The legal environment was also influential as the accounting fraternity was highly regulated. Hence the regulations also dictated the technology usage.

Participant **#1** elaborated that compliance with the legal requirement may influence accountants to implement certain technology.

"The other thing we can say is the legal environment that I think comes into play. The environment that you operate in may force you to adopt certain technology because if you want to maintain the traditional system which means your reports will not meet current legal requirements and reporting standards like now accountants have to report on the impact of business activity on the environmental".

Participant **#12** indicated that the legal requirement from government institutions can influence accountants to adopt new and innovative technologies.

"The legal requirement so the revenue authority as they want the accurate document, they want documents in a certain format, for example, there is a certain requirement the Companies and Intellectual Property Commission (CIPC) requires that we submit our documents in which is the latest technology thereby forcing you to adopt that particular technology for compliance purpose. For example, if the government says you have to use SAP, then rules are rules, so that would definitely have an influence".

The study shows that the adoption of Industry 4.0 is influenced by regulations. Uncertainty in the law and regulations could slow the introduction of robotics and other data-driven services or products. The introduction and adoption of modern technologies is complicated by outdated business regulations (Volkodavova *et al*. 2019). Therefore, the development of information systems requires appropriate legislations. These regulations could be copyright and legal laws that protect new products, trademarks and company logos (Iqbal and Yadav, 2020). Due to security and regulatory issues, the process of digitalisation could be hampered (Sorkun 2020). There is a dearth of regulation in the existing legal

guidelines for Industry 4.0 as well as uncertainty about how these rules will be applied to emerging technologies. However, technology advancement may be stimulated or inhibited by government regulation. Modern technology tends to be safer, so regulations intended to minimise some risks ought not to discourage innovation. This finding aligns with the Institution theory which posits that organisational decisions, such as the adoption of new technology like Industry 4.0, are influenced by institutional pressures. The pressures can be regulatory, normative, or cognitive (DiMaggio and Powell 1983). In the context of the accounting profession, these could include accounting standards, data protection regulations, or regulations specific to the use of certain technologies.

4.3.2.2 Financial and resources

Financial and resource factor were the second highest determinants of technology adoption. This is informed by the following.

4.3.2.2.1 Financial

Financial factors were the most highly ranked. This is because some organisations needed finance and money to implement change from manual to automation. The bigger the organisation, the more money they would have to invest in technology versus the smaller organisations with lesser finance.

Participant **#4** believes that the financial resources of an accounting firm has an influence on new technology adoption.

"I think the size of your firm plays a role on the adoption of certain technology because bigger firms have more money and more time to invest in data analytics and they can afford to hire the skilled staff to come in. So, client's environment has to be conducive to using data analytics".

Participant **#13** explains that the financial resources of the organisation significantly influence all aspects related to new technology adoption and implementation.

"The financial resources of an organisation will help in all aspects whether it's for acquiring the modern technology, acquiring the skills and the training for the employees… therefore the resources of the organisation significantly influence the adoption of Industry 4.0".

Participant **#9** indicates that big accounting firms have the financial resources to acquire and maintain new technology.

"Big businesses service big clients which increase their disposable income and are able to invest in new technology… and that makes them attractive to other client because of services they offer but they also have the ability to conduct research and develop their own software for example Deloitte was recently testing blockchain technology".

Participant **#11** also had similar views on the influence of organisations' financial resources in the firm's ability to adopt and implement new technology.

"I have to look at the size of my business for instance as smaller company I'm likely going to outsource the accounting package because sometimes those companies they charge per the number of transactions, the number of companies, number people that use it therefore for a small organisation it is going to be cheaper for me who's going to do fewer transactions and few employees that would be using it".

The study found that a firm's financial position significantly influences Industry 4.0 adopting in accounting. Financial resources influence the type of investment, talent acquisition and infrastructure undertaken by a business. Financial constraints can be an impediment for Industry 4.0 adoption that call for extensive investments. Additionally, the financial resources of the business influence the skills acquisition and development required to operate these technologies. The competence of human resources involved in the compilation of financial statements has a significant impact on the accuracy of financial statements. Gupta *et al*. (2018) found that many businesses may not have the financial resources required for essential expansion and servicing of their digital infrastructure.

4.3.2.2.2 Resources

Related to financial, came the aspect of resources. Some companies had limited resource capabilities to invest in technology. In addition, there existing resources were sufficient to continue in a manual method. However, growth and progress could bring in added resources to adopt technology.

Participant **#1** suggests that firms' resources influence the type of technology they implement.

"But we cannot ignore the issue of resources because I can't expect a small accounting firm to deploy technologies like blockchain, artificial intelligence because of the cost and resources required to research and implement these technologies as compared to big accounting firms… for example if we get client that needs auditing service, we refer them to other firms that have the capacity to do that".

Participant **#2** believes that small accounting firms do not have resources to invest in and implement Industry 4.0 technologies.

"When considering implementing certain technology for instance small accounting firms cannot have the resource to invest in latest technology like blockchain because it requires a lot of financial outlay and research that small business do not have".

Participant **#10** raised the issues of resources required to build and maintain Industry 4.0 systems.

"The issue of resources is something that you have to really consider then realise that you need to have infrastructure and systems to manage the workflow, you need to have a system to manage efficiency and productivity".

The views expressed by the above participants reveals that the resources of a business influence Industry 4.0 adoption and implementation. Lack of knowledge of the Industry 4.0 and its capabilities may cause a doubt of the future and may prevent its acceptance or implementation. The study finding is aligned with Wang *et al*. (2019), who posit that the availability of resources and proper infrastructure are a major factor in determining a company's behaviour towards the adoption of new technologies. The ability and desire of employees to experiment with new technologies has an impact on the company's behaviour intending to implement new technology (Wong *et al*. 2020b). Business technology adoption is facilitated by an organisation's ability to provide the necessary human resources and information technology (IT) infrastructure (Alkhater, Walters and Wills 2018). For example, providing resources for sourcing skilled employees and training

existing employees. Additionally, Yang *et al*. (2015) explain that failures in technology adoption might occur because of inadequate technology resources and a lack of support from senior management. The finding aligns with the TOE theory. Organisational factors include aspects such as the size of the firm, its readiness for change, and the resources available for technological investment. In the context of small accounting firms, limited resources have a significant barrier to the adoption of Industry 4.0 technologies. This includes financial resources for investment in new technologies, human resources with the necessary skills to implement and use these technologies and time resources to manage the transition to Industry 4.0. The finding that business size and processes influence the adoption of Industry 4.0 in accounting aligns with the TOE theory.

4.3.2.3 Business size and processes

The size of the business and its processes thereof was another main factor. This is informed by the following. In addition, the smaller the company the more inclined they were to use traditional manual methods as their data volumes were not as high as larger companies. Hence the more a company grows, the more they would adopt technology.

Participant **#8** highlights that the size of the business and its processes have an influence on technology adoption.

"The other reason why accounting is adopting digital technologies is due to the increasing demand, businesses started growing bigger, and accounting is one of the organisation functions which had to be done irrespective of the size. As time passed it became difficult to manage the accounting of large companies without using machines. As a result, the accounting profession was faced with a lot of challenges and needed to consider the adaption of technology".

Participant **#10** suggests that new and innovative technology presented by Industry 4.0 enables small accounting firms to be competitive and efficient in the marketplace.

“I think as a company grows and you can't survive without having this cloud based software’s because technology allows us a small business to be able to compete with bigger entities and be able to service them and deliver consistent quality type of work…inefficiency is not something that the client can value, so I think that also shapes how you are doing”.

Participant **#12** explained the impact of firm size on its ability to adopt Industry 4.0.

“I think you have to look at your size for example can you handle the amount of data that you receiving given the size of your organisation and the data that you want to handle… so if you have smaller size business you likely going to go onto the cloud because you didn't want to buy this software, have storage space for the servers, make sure that security is there to keep this server so you would then have to go to a cloud service because it will be cost effective for you because a bigger business can still afford to have their own private virtual network or onsite network because they have the means to do that so. I can say for accountants it’s the size because the smaller you are the more you need to operate on the cloud”.

The study finding shows that the size of the business and its processes has an influence on the implementation of Industry 4.0. This could be the case because of the amount of capital that businesses need to be invested in acquiring, developing, and maintaining some of the software. The study results align with Fu *et al*. (2018) who found a statistically significant and positive relationship between the size of a business and technology adoption. Larger firms might have more financial resources for technology investments and the internal expertise needed to carry out complicated projects. In addition, Salah, Yusof and Mohamed (2021) found that business size as one of the determining factors for technology adoption by firms. Larger businesses have been found to be more likely to implement new technology because they have the financial resources and expertise to do so, as well as economies of scale to maximise the return on such investments (Horváth and Szabó 2019). As firms expand tasks become more complex and human resources also increase requiring the implementation of systems to improve efficiency and productivity. The adoption of new

technology requires research and development on the compatibility of the intended system with the technology in use. The finding is supported by TOE theory which posits that the adoption of new technology in an organisation is influenced by technological, organisational, and environmental factors (Tornatzky and Fleischer 1990). Organisational factors include aspects such as the size of the firm and its internal processes. Larger firms may have more resources to invest in new technologies like Industry 4.0, and their processes might be more complex, potentially benefiting more from the efficiencies offered by Industry 4.0. Conversely, smaller firms might face resource constraints, and their simpler processes might not benefit much from Industry 4.0.

4.3.2.4 Employees skills

Employees would need to be sensitised to new systems to avoid resistance, and they would need to be competent to adapt to new technology. To adopt technology, the right skillsets were needed at the organisation. The Industry 4.0 technology required specialised skills to understand and utilise. Hence skills development was essential. Skills development would also make employees less fearful of change.

Participant **#3** elaborates that relevant skills are required for the implementation of Industry 4.0.

"The level of competency and the skills of your staff can be a factor in you acquiring new technology because these technologies are evolving at a rapid pace, so you need to constantly upskill your employees… for example couple of years ago we didn't know about machine learning, Internet of Things, blockchain, data mining and many more... but competence and skills of staff must not be a stumbling block for the organisation to adopt new technology because they can be trained to use the new system. I think new systems have been coming now and again and staff have been upskilled so you can upskill your staff".

Participant **#4** further explains that importance of having the right skillset during technology adoption.

“As the employees are more competent in data analytics and those type of things then the ideas come from them, but I think most of the technology is like Microsoft Excel is very readily available, but we just need to learn how to use it”.

Participant **#3** suggest that there is a need for employees to be trained on new technology to help them acquire new skills.

“…and based on that you know every system needs you to train people you can't run away from that, so you need to train people. if the employees competencies are not up to standard then you can upskill them by sending them for trainings and that is part of their development as well… so I feel like in terms of employee competence it's something that can be dealt with internally or if you feel like these people are not able to use the technology and then maybe you can get someone who can use the technology”.

Participant **#10** explains that accountants need to keep reskilling themselves to stay abreast with technological change in the profession.

“But also, you don't want to be obsolete because everyone is moving in this direction, so you want to get that first entrance advantage and to be one of the players and our professional bodies offer us webinars, trainings to ensure that we as accountants are fit for the future and the profession doesn't die but we are being equipped with the necessary skills”.

Participant **#2** highlights the need for an organisation to consider the skills their employees poses before adopting new and innovative technologies.

“Your labour force in terms of their competence because you need to ask yourself that do I have competent staff to run and manage this system you intend to acquire and are they competent enough to move over to the system entirely or should we still keep some of the outdated systems and maybe slowly have sort of half and half in that situation”.

The study reveals that employee’s digital skills and competence influent businesses to adopt Industry 4.0 in accounting. Industry 4.0 may require employees with transversal skill and competences. Skilton and Hovsepian (2018) found that the new era of technological convergence will require new skills and a new language to leverage the benefits of these innovations and understand the

consequences. Inevitably, new occupations will be created because of technological advancements while others will vanish altogether. For instance, remote-control system will be used to run intelligent factories with human involvement at least through the internet. The skills needed to implement Industry 4.0 vary slightly from one sector to the next. The transition to Industry 4.0 would include solving tasks relating to the application of skills, creativity, and the management of smart businesses through the Internet (Kolesnichenko, Radyukova and Pakhomov 2019). Therefore, shifting the focus to individual competence rather than qualification. In Industry4.0, the most important attribute for most future employees is the skill to use knowledge to create value in a collaborative way across different fields. This finding supports the relevance of the TOE theory to understanding the adoption of Industry 4.0 in the accounting sector in KwaZulu Natal, South Africa. It suggests that to facilitate the adoption of Industry 4.0, it is important to consider the skills of employees and how these can be developed. Additionally, training existing employees in data analysis and programming skills can be costly and time-consuming.

4.3.2.5 Stakeholders

Stakeholder pressure was an added key factor for the adoption of technology. The pressure from all stakeholders holistically inclusive of SARS, other governmental and private enterprises required accounting firms to update and upgrade their systems. For example, SARS was leading in terms of e-Filing and making tax submissions seamless through digital documentation and certificates. Hence it was important to adapt to their system for added compatibility. Customers were also key stakeholders. In today's digital age, most customers were online bother through systems and social media. Hence, social media was an ideal way to recruit new clients and establish client trends as well as keeping in touch.

Participant **#6** shared the following views regarding the influence of firms' stakeholders on the organisations' technology adoption.

"Accountants may also be influenced to adopt new technologies because of the pressure from other stakeholders for example South African Revenue Service

requires that accountants install a particular software in order to communicate with them, so you are forced to adopt that technology for compliance purpose. So, these forces accountants to install and adopt that software because of the pressure from SARS".

Participant **#7** believes that the environment in which the firm operate has an influence on the firm's technology adoption

"I think the environment you operated can fluence you to adopt technology or sometimes maybe the pressure from the government for example, there are certain packages that would apply to your business and also can you also interface with organisations like SARS if you want to do tax returns once it's there in the system you link it to SARS for you to submit tax returns…and can it interface with bank when you want to do payroll so the issue of compatibility…so those are the things that are the main factors when we want to acquire certain technology".

Participant **#12** suggests that the pressure from regulatory bodies and government does influence accountants' behaviour towards implementing new technology.

"Pressure from government or regulatory bodies can actually influence one to adopt new technology for example if you're running payroll on SARS easy filing system it allows you to run and capture 50 employees IRP5 certificates manually in to the system but once that number of employees goes beyond 50 employees you will be required to capture employees IRP5 certificates electronically through e-filing system which means you are now forced to adopt this new technology whether you want it or not… because of that legal threshold so this kind of situation where we are forces to adopt a certain technology because the capabilities of the old technology can no longer meet the legal requirement… this could be because they want to create a standard".

Participant **#1** points out pressure from clients may accelerate the need for the organisation to digitally transform.

"and also, the pressure might come from your clients who might need the flexibility brought by new technology… for example online shopping but also this

technology should be easy to use and add value otherwise employees and customers might become frustrated with technology and abandoned it or they may decide to go back to the old way of doing things".

Participant **#9** explains that clients have the power to dictate whether the firm adopts modern technology.

"I would say your clients will influence whether you adopt or not because you can't adopt new technology when your clients are still using old technology and vice versa".

Pressure from customers, suppliers (accounting regulatory bodies) and government institutions influence businesses to adopt innovative technologies presented by Industry 4.0. The pressure may originate from customers who prefer flexibility brought by technology. For instance, online shopping in which customers shop at their convenience without time constraints in traditional brick and mortar shops. In addition, incompatible technology could put pressure on the business to implement certain technology to conform to the industry practices. Government regulations can influence businesses to adopt a particular technology for compliance. The finding is aligned with Jiao, Liu and Xu (2020) who revealed that pressure from the stakeholders had a direct influence on the adoption of sustainable operations by manufacturing firms in China. Regulatory stakeholders often possess coercive abilities that compel firms to conform with certain requirements to prevent legal penalties (Baah, Jin and Tang 2020). The finding is aligned with the Institutional theory which explains that isomorphic and legitimacy pressures cause firms to grow more similar (DiMaggio and Powell 1983). This suggests that over time, businesses in the same sector tend to resemble one another as pressures from customers and other stakeholders drive them to imitate industry leaders (Latif *et al*. 2020). The pressure from all stakeholders required accounting firms to update and upgrade their systems to meet the demand of the contemporary business environment.

4.3.2.6 Organisation Culture

Furthermore, an organisation's culture determines technology adoption. If the organisational culture was technology orientated, then technology adoption

could be easier. One respondent asserted that as an industry leader, it would be good to create a technology influence culture for others to follow.

Participant **#6** believes that the culture entrenched in an organisation has a significant influence on Industry 4.0 adoption.

"Accountants may also be influenced to adopt new technology because they want to follow industry leaders. Industry leaders act as influencers to other organisations in most cases the small organisations just follow them but also these big organisations have a significant influence in the industry they operate and have a big lobbying power. It may be the case that they want legitimacy and to feel that they belong".

Technology adoption can be influenced by the culture of an organisation. The adoption of new technologies has largely failed as a result of organisational culture. Businesses that encouraged employees to embrace new technologies also had a higher propensity to experiment with modern systems (Roberts *et al*. 2021). Management's reaction to the adoption of technology can either be slow or quick. Therefore, resistance to technology adoption within an organisation could be linked to the culture that is embedded in the organisation (Miranda *et al*. 2017). Moreover, institutional theory explains that an organisation's performance is measured by how well it embraces social values on rational behaviour (Baker *et al*. 2014). Organisations may decide to follow the formal structures and procedures that are accepted in their social and cultural context in order to attain legitimacy and obtain the resources required for survival (Craighead *et al*. 2020). Therefore, organisation culture has an influence on technological implementation within an organisation. Organisation procedures that direct daily operations affect business readiness to implement innovative technology.

The study findings align with both institution and TOE theories. Organisational factors include aspects such as the culture of the firm. A culture that is open to change and innovation can facilitate the adoption of new technologies like Industry 4.0. Conversely, a culture that is resistant to change can be a barrier to adoption. The Institution theory suggests that organisational decisions are influenced by institutional pressures, which can be regulatory, normative, or

cognitive (DiMaggio and Powell 1983). Cognitive pressures include shared beliefs and common understandings within an organisation, which are part of its culture. If the culture of an accounting firm aligns with the adoption of Industry 4.0, this can act as a cognitive pressure supporting adoption. This finding supports the relevance of both the TOE and the Institution theories to understanding the adoption of Industry 4.0 in the accounting sector in South Africa. It suggests that to facilitate the adoption of Industry 4.0, it is important to consider the culture of the organisation and how it can be nurtured to support change and innovation.

4.3.2.6.1 Working model

The working model could provoke a remote working culture thanks to technology which could be favoured by employees in terms of working from anywhere at any time.

Participant **#9** points out that cloud storage enables accountants to access information from anywhere thereby enabling remote working.

"For example, cloud-based technology that allows you to store your documents online and you can access them anytime anywhere but also enable you to work remotely so you can attend to your client even if you are on a holiday somewhere".

Remote work has been influenced by the advancement of technology. The advent of Industry 4.0 has accelerated remote work implementation by many organisations. Collaboration technologies can enhance remote communication by better supporting visual and verbal clues. This may be facilitated by the interconnective of devices in the Industry 4.0 ecosystem and the ability of machines to communicate with each other and machines with humans. Attitude surrounding remote work has undergone a significant adjustment. Modern technology has caused changes to the workplace. Remote working has allowed flexibility at work where employees can choose to work from home or the office.

4.3.3 Sub-theme 3: Opportunities presented by Industry 4.0 in accounting.

This primary subtheme examined the opportunities presented by Industry 4.0 in the accounting fraternity. There was a plethora of opportunities each unpacked below.

4.3.3.1 Information and data

Information and data were logically highly ranked opportunities. This was for the following reasons.

4.3.3.1.1 Access to real-time information

The advent of real-time information has made the availability of updated information seamless, and this support effective and efficient decision-making and access to updated information by customers. The access to information due to cloud technology makes information readily available to stakeholders at any time and from anywhere provided they have internet connectivity. This enhances transparency and knowledge for stakeholders. Processes such as audits can also be done seamlessly.

Participant **#1** explains that accountants are able to collect information in real-time due to Industry 4.0 technologies.

"…but the information is also available in real-time. The availability of information in real-time helps management to make quick decisions for example immediately a transaction goes from your bank account its reflected on the other side not like those day of the cheques whereby you had to wait for the cheque to be posted and the bank also takes time to process before you can get money into your account".

Participant **#8** elaborates that Industry 4.0 presents an opportunity for accountants to share information with their clients at any time.

"By providing digital services, they can improve their practices. Customers now have easy access to the company's statutory and administrative reports, facilitating day-to-day operations and significantly improving the efficiency".

Industry 4.0 has enabled information to be collected in real-time. Accountants can now gather information on business transactions in real-time due to advanced technologies like Artificial Intelligence, big data, Internet of Things. Gauzelina and Bentza (2017) found that real-time information facilitates quick decision-making by management. The incorporation of artificial intelligence into accounting will undoubtedly influence how data is collected, analysed, and shared. Historically, financial statements provide stakeholders with information drawn from past financial transactions for decision-making. In the age of real-time information gathering, businesses need access to current data that can fully explain the myriad of business transactions (Peters *et al*. 2020). Therefore, real-time information promotes improved decision-making for accountants holistically.

4.3.3.2 Reports

Compilation and preparation of reports are easier with digital information as opposed to manual compilation. Reports are ever more accurate and updated.

Participant **#1** highlights that the adoption of Industry 4.0 has made the compilation of financial statements and reports effortless and quick.

"…right so in terms of compilation of reports and financial statements, this has changed in such a way that work is now being done even much quicker and more precisely and it's much more accurate which is the biggest advantage that the emergence of Industry 4.0 has brought".

Preparing and compiling financial statements has been made easy and quick with the advent of Industry 4.0. For instance, accountants do not need to perform bank reconciliation manually because this task can be automated. In addition, data capturing, and other back-office tasks can be automated. The data entry process can be carried out automatically including reports that were formerly compiled by accountants. Furthermore, robotic process automation is useful for automating rules-based processes like accounting transactions that have a predictable flow and consist of repeated steps with well-defined inputs and output (Aguirre and Rodriguez 2017). Robotic process automation technology mimics people in order to automate structured operations in a timely and cost-effective manner. Robots can be programmed to perform a variety of tasks, including reading emails, opening PDFs, entering data into ERP systems, and alerting

designated supervisors through email when they detect errors (Moffitt, Rozario and Vasarhelyi 2018).

4.3.3.3 Communication

Communication is greatly enhanced through technology in the following ways.

4.3.3.3.1 Social media

Social media such as Twitter, Facebook and WhatsApp enabled instant communication and information access for clients and other stakeholders. Such platforms also reached a wider population of clients.

Participant **#3** points out that accounting firms are now embracing social media platforms as medium of communicating with clients and other stakeholders.

"Also, Twitter has become popular application that organisation use to communicate with their stakeholders, you have seen if an organisation wants to communicate an urgent message, they post it on their Twitter page for quick access by their followers".

Participant **#5** explains that social media platforms like Twitter enables accountants to instantly share information with stakeholders.

"With the communication channels like Twitter and these others so you can always post your information in there and it is available to all stakeholders immediately and you can also get stakeholders reaction immediately".

Participant **#6** expressed that Industry 4.0 offers accountants multiple communication channels for sharing information with the firm's stakeholders.

"Industry 4.0 also brought in multiple channels of communication between accounting firms and their stakeholders, for example most organisations now have business WhatsApp, Twitter, Instagram that they use to communicate important information to their stakeholders. This is an effective tool considering that most people now have access to cell phones that are loaded with these applications".

Participant **#9** believes that social media platforms make it easy for accountants to disseminate information.

“Some of these communication channels like say WhatsApp, Facebook and other social media platforms makes life easier because if you can’t reach someone on e-mail you can reach them on WhatsApp and with these social media platforms and you are able to see that someone is available online as opposed to an email that you sent while hoping they read it and get back to you soon. But also, organisation now can collect information from these social media platforms for example if you want to know more information about your client you can check what they are doing through their post on social media”.

Participant **#1** suggests that accountants now use social media platforms as official communication channels.

“There are some organisations as we speak that actually use social media as official communication channels like WhatsApp, some have Facebook and Twitter account that they used to communicate with the public because we need to understand the fact that the times in which we are living in most people don’t really on their computers but most people are on their phones… and on those phones there is Facebook, there's WhatsApp, there's LinkedIn and that's a quick way of communicating to people”.

Social media has enhanced communication between accountants and other stakeholders. Social media presents an opportunity for accountants to communicate and receive instant feedback from clients and other stakeholders. Social media data are increasingly being used within businesses as an internal report (Agostino and Sidorova 2017). Moreover, social media has evolved into a complex informative platform for financial statement disclosure. In the past, businesses relied on email to disseminate their annual or financial reports to the stakeholders. Social media links together stakeholders and allows businesses to have conversations with their shareholders about important issues like financial performance of the organisation. Since more millennials are becoming investors, communications made through social media have become extremely important. Social media allows an organisation to manage the information they communicate to their stakeholders (Boylan and Boylan 2017). Social media is more cost-effective means of disseminating information to the great public.

Additionally, social media platforms enable organisations to share information more freely.

4.3.3.4 Cost saving

There were cost-saving opportunities, especially from a Labour cost perspective.

4.3.3.4.1 Labour costs

Labour costs can be significantly reduced as less labour is involved in online transactions. Online reports can be prepared seamlessly, thus mitigating the need for human and manual labour in all financial and data processes. The clients also do significant work on their side though uploading of electronic documents thereby minimising the work of the accountants.

Participant **#1** suggests that implementing Industry 4.0 helps an organisation to save on labour costs.

"The big advantage in terms of cost savings is when you save on time… it means that you are actually saving on costs as well where for instance, when you are supposed to pay an accounting clerk, debtors clerk or wages clerk whatever the case may be on an hourly basis it means that the time they were going to spend compiling their report has been reduced significantly… and that reduction in the time of work that was supposed to be put in there also means that the cost that also go with that work comes down… so you would then say that with the coming down of the cost… businesses are now realising more profits and which makes business grow and as business grow which means that there's creation of employment so there's a positive ripple effect".

Participant **#5** explains that adopting Industry 4.0 will reduce the need to employ human labour because some activities can be automated, thereby reducing the cost of labour.

"Because of Industry 4.0 in the sense where someone resigned, or someone retires you don't need to replace that person now if the tasks they used to do can be automated, so in that sense that's where the labour costs are reducing at the moment".

Participant **#10** believes that implementing Industry 4.0 does reduce the time accountants spend on collecting and preparing financial reports because clients can also be involved in the processing of financial information.

"Labour costs have significantly reduced because a lot of the work that we do as an accountant is preparing the data that's to be used in a simulated financial reporting, so the emergence of Industry 4.0 has resulted in a collaborative work where the client does most of the work because the process has been simplified. In the accounting space a lot of work goes into gathering and preparing actual data for you to be able to run the reports remember the objective is for us to prepare valid, accurate and complete financial reports of which we need the data. But to capture that data we need to spend a lot of time going through paging through invoices spend a lot of time capturing those invoices on the accounting software of which now through the beauty of Industry 4.0 we have seen now that we don't really have to spend a lot of time now having to capture because the systems that have been put in place. Like for instance the new accounting software now integrates with your banking app. We now don't have to wait till the end of the month for the client to send us bank statements… each time a client makes a transaction they get automatically linked to the accounting software so the system now allows you to capture the information about the supply invoice and reconciling that against the payments thereby eliminating the need of having someone like creditors clerk or debtors clerk… this therefore then leads to some costs being eliminated where certain roles are being automated which reduces the labour cost allows you to be able to do more work with less labour costs".

The study finding shows that the adoption of Industry 4.0 has contributed to the reduction of time spent to perform certain tasks and lowered the cost of labour due to automation of some jobs previously performed by humans. In addition, implementation of Industry 4.0 boosts productivity and improves efficiency. The primary advantages of Industry 4.0 are the decrease in production costs, production times, and the enhancement of product quality. There is an opportunity to save time, money, or both by incorporating digital processes into the operations. Implementation of enterprise resource planning systems increased operational effectiveness and resulted in significant cost savings (Asprion, Schneider and Grimberg 2018). The application of artificial intelligence

in businesses contributes to a considerable reduction in labour expenses and hours worked. Robots are trained to perform repetitive jobs more quickly, accurately, and consistently than humans. Therefore, robot technologies are commonly deployed in disciplines where processes rely on repetitive, rule-based data inputs. For instance, the capabilities of chatbots and other forms of virtual assistants are expanding rapidly, and they are currently being used in administrative tasks and communication.

4.3.3.5 Virtual

Virtual meetings can save costs of logistics and travel and save time in terms of scheduling. In addition, virtual meetings can increase attendance because of their scalability and wide geographical reach.

Participant **#12** shared the following views regarding virtual meeting platforms.

"Instead of just meeting face-to-face which was the case traditional… but now we have the option to actually attend the meet virtually via different online platforms like Zoom, MS Teams and many more, so this goes a long way in cost reduction because we would have to pay for hotel and transport and the food just to host these delegates or higher management people that might be coming for general meeting but also these online communication platforms have reduced the distance between people that are in geographically dispersed".

The views shared by participant **#12** reveal that virtual meetings reduced the cost associated with organising face-to-face meetings. Unlike in-person meetings, which are limited in the number of people they can host, virtual meetings have the distinct benefit of being easily expandable, both in terms of the volume of guests and the locations they may reach. This not only allows participants more autonomy in terms of their availability, but it also has the potential to link people from all over the world by removing the expenses and inconveniences of physically meeting in person. Because they are not limited to a specific location, virtual meetings have the potential to attract more people from more places. The finding is supported by Achakulvisut *et al.* (2021) who found that virtual meetings reduced the cost of both hosting and attending a meeting. This includes both the registration costs and travel expenses of the participants.

4.3.3.6 Productivity

Technology is logically meant to complement productivity.

4.3.3.6.1 Increased productivity

Technology can mean the reduction of repetitive tasks and manual processes. Efficiency can increase and errors can be minimised. Productivity can therefore increase in multiple ways. In addition, the added speed of the automated process and the reduction in time and means that excess labour can be used towards other tasks or perform multiple tasks. Relating to productivity comes the key aspect of speed. Technology makes things faster. All financial processes, transactions, and data management can be done faster with minimal to zero errors. Document flow and transactions can be faster through automated systems and electronic documents thereby saving time and money.

Participant **#3** highlights that firms that implement Industry 4.0 are likely to realise improvement in their production processes and efficiency.

"Most of the jobs now is being done automatically so it means the employees have more time now to do other ad hock tasks, and so this translates to more production because the same employees now have more time to do other tasks as compared to what they used to be doing before".

Participant **#6** suggests that data processing has improved since the advent of Industry 4.0.

"Data processing has significantly improved considering that information can be gathered in real-time but also the speed of new computers has significantly doubled which means improved productivity whereby an individual can perform multiple tasks".

Participant **#8** points out that Industry 4.0 is transforming how accountants perform their duties.

"The duties and activities of Accountants are changing; customers' expectations are becoming specific and continuously increasing; the workload and work pressure on employees has been reduced; repetitive tasks are easily executed

and more efficiently. The use of new technologies has significantly improved performance productivity of firms".

Participant **#9** explains that automating processes decreases errors and boosts productivity.

"In terms of productivity, it's very good you get work done in a smart and simpler way as compared to the manual system we previously used. Automation of accounting systems are likely to improve efficiency because there will be few errors but also increase productivity".

Participant **#10** also concurs with other participants that the adoption of Industry 4.0 improves productivity.

"Productivity has drastically been enhanced with cloud-based systems where more than one person can work on the same file rather than having a desktop machine where only one person can work in that file at a time… and then they need to transfer it to another person by USB but on cloud everyone can work on the same file there's a lot of collaboration that means more productivity. So, you can get a project done in short time that could have taken days because someone has been used to sending the file to the reviewer and the reviewer make some notes then they send it back and they need to now to reopen the backup and then make the changes then send it again… but now you know everyone is collaborating with one another it's easier you can have four people processing the same bank statement all at the same time".

The finding indicates that implementing Industry 4.0 boosts productivity. Industry 4.0 allows accountants to automate processes through the integration of artificial intelligence into those aspects of a business's operations that require making straightforward decisions. Therefore, Industry 4.0 will lead to fewer administrative offices, more productivity in technology-intensive procedures, and lower operating costs. The success of a business depends heavily on how quickly and reliably it can handle its tasks. Industry 4.0 boosts operational output through enhanced processing speed and fewer errors. In addition, digital and remote control of operational processes has increased system accessibility. Therefore, wastage will go down because of modern technological advancements and greater monitoring, resulting in lower overhead expenses (Cagle *et al*. 2020). A

more efficient system will decrease the cost of essential resources like water and electricity.

4.3.3.7 Data recovery

Data can also be recovered from the cloud during the events such as fires and flooding. Unlike previously when physical data could be lost.

Participant **#11** explains that cloud storage provides firms with peace of mind in terms of data storage and recovery in case of unfortunate incidences like cyber-attack and other disasters.

"If there is a fire outbreak… we are no longer afraid… the fire can destroy some of the files but if we have some files backed up in the cloud you just reboot your system or take another PC and download all the documents from the server so that's an opportunity that business did not have".

Industry 4.0 has enabled businesses to back up their information in the cloud system. With Industry 4.0, businesses can recover their backed-up information in case of any disaster. Backup systems are essential since they serve as the cornerstone for restoration and the final line of protection against many serious threats. The key to successfully recovering from lose of information is maintaining the backup storage independent from the regular data storage. The study finding is aligned with Öztürk, Pekkaya and Temli (2020) concur that businesses can reduce the likelihood of permanent data loss by using a reliable backup system. Some businesses may be concerned about the potential loss for data and illegal access to sensitive information but, these threats can be mitigated with the help of backup and alternative cloud setups.

4.3.3.8 Flexible working

Flexible working can also become possible due to technology. Accountants do not have to be seen as people who only work from the office as per traditional methods. They can now work remotely as all accounting and financial systems can be online.

Participant **#1** points out that Industry 4.0 is transforming the office setting by facilitating remote working.

“Digital technologies have changed the work environment of accountant like most of the time now I work from home which has save me the stress of sitting in traffic and petrol imagine during lockdown everybody was working from home thanks to technology and I don’t think we will go back to the traditional office setting but possibly a hybrid system of working”.

Participant **#9** indicates that Industry 4.0 has enabled accountants to work remotely due to improvements in technology.

“But with technology now you can work from anywhere you see now people work from home or remotely thanks to technology, but also you can have great reach with your business considering that you can sit here in Durban but can service client from Cape town, but it also helps businesses break new barriers”.

Participant **#10** explains that accountants can now work from home because they have access to information stored online.

“We use cloud-based storage where we store everything for our clients and the cloud allows us to work from home so where we all working on the same file and on the same software were everything we do is on the cloud, we don’t have a single software we are using on one device everything under process workflow is on cloud and which means we can work from anywhere and majority of our staff works from home and only those staff that obviously prefer to work in the office only work in the office in such a way that we only have a small office but we have staff complement of more than seven people which can operate from anywhere”.

Participant **#12** also believes that Industry 4.0 has brought in technologies that facilitate remote working.

“Industry 4.0 has improved the flexibility of work, we are talking now of remote work, hybrid work and holiday work most of this has been influenced by Industry 4.0 imagine with these recent lockdowns if we didn’t have these technologies, it would be a total mess or it would have been difficult to implement because there would have been some resistance”.

The advancement in technology has brought flexibility in working schedules for accountants. Cloud storage enables accountants access to information from

anywhere at any time. This allows accountants to work from home at different times. With the advent of remote working, accountants are no longer constrained to settling in close proximity to their place of employment. Remote working therefore allows for greater geographic mobility and the possibility of continued employment with a given firm regardless of the employee's physical location. When accountants work remotely, they can save on costs associated with work clothing, given that workers have the freedom to choose how they dress for work. Accounting firms can also save money on rent by letting accountants work remotely. But this benefit also extends to accountants as well who will save on travel costs. Kicheva (2021) suggests that businesses can save money on rent, utilities, and other overhead expenses. Due to less time spent commuting, workers may be able to work longer hours every day.

4.3.3.9 Data storage

The ever-increasing volume of data will always require added storage and access. Manual storage is outdated due to limited space and escalated costs. Hence virtual storage is possible due to technology. Virtual cloud storage can accommodate unlimited data at minimal costs. Data is safe and accessible/ retrievable at any time.

Participant **#1** suggests that cloud storage has brought improvement in data storage capacity for accounting firms.

"It has also brought in improvement in data storage capacity whereby now you have cloud storage applications like OneDrive, drop box and many more cloud-based storage as opposed to the old filing system and also most accounting packages now come with cloud-based option".

Participant **#3** suggests that accountants no longer need a physical storeroom for documents because all documents can now be stored electronically.

"Quick data processing at a lower cost as compared before because remember there was a need for documents to be stored physically but now the documents can be stored electronically so that it does not require too much space as compared to the physical document storage is before in the accounting firms they can save on labour".

Participant **#5** explains that large volumes of data can now be stored in smaller devices.

"Then in terms of storage as I said earlier, we used to have big machines holding certain amount of data but, nowadays we have small device that can hold so much data… so I think that's the benefit in terms of data storage you don't need too much space for storage you just need a normal space with a small device that can hold so much data".

Participant **#6** elaborates that cloud storage scalable capabilities allow accountants to store and share large documents.

"In addition, the emergence of Industry 4.0 has seen an improvement in data storage capacity for most organisations because of systems like cloud computing, cloud storage like OneDrive, drop box which help organisations to store their information online and also share large documents which was not possible previously… and this also helps accountant to collaborate as more people can work on one document by them login to the system they will be able to download the file and work simultaneously with other colleagues".

The emergence of Industry 4.0 has brought in improvement in data storage capacity in accounting. Cloud computing allows for the collection and storage of massive amounts of data. Al Hadwer *et al*. (2021) found that cloud technology facilitates the usage of various cloud-based software, such as accounting and document management systems. Data storage enables the use of shared resources, resulting in the improvement of company operations. Storage costs may decline because of improved online document management made possible by cloud storage. Cloud technology offers a solution to the challenge of data storage because of its scalability capability. Accountants work with massive amount of data generated from different business transactions. Therefore, cloud technology offers accountants the best option to store massive amount of data.

4.3.3.10 Business development

Business development can improve due to the following technology enabled processes.

4.3.3.10.1 Marketing

Social media platforms can also be used as marketing tools for the firm. These options can be cheaper, quicker and less labour intensive as compared to traditional methods of hard copy marketing and radio and TV.

Participant **#5** suggests that accounting firms can advertise themselves through social media platforms without the need for traditional advertising agencies.

"If we look at marketing from aspects of communication from what people are communicating on social media, you can learn so much about what they want to buy or what they need and then you can be able to do you can have targeted advert. Most businesses now use social media platforms to communicate and share information with their stakeholders… for example, you have seen statements being issued through Twitter and with business WhatsApp has become an important application for businesses you can even sign up for a contract through WhatsApp by you just following step by step guide on the App".

Participant **#6** explains that accountants can harness the power of social media to market their services and products.

"Industry 4.0 presents an opportunity for accountants or accounting firms to market themselves in social media platforms… this translates to an increase in revenue for accounting firms because previously marketing was mainly done through print media and television or radio stations which was costly, with social media an organisation can promote themselves without using the traditional marketing channels because most of these accounting firms have a big social media following which makes it easy for them to send out targeted advertisements".

Social media platforms offer accountants an opportunity to market their services to the public. Social media marketing is cost effective and offers instant feedback and engagement with clients. Social media platforms make it possible for users to produce high-quality content. Accounting professionals are coming to recognise social media as a valuable tool that may help them achieve their marketing objectives. Social media advertising campaigns can be targeted to a specific audience. Accounting firms benefit from social media since it expands their reach to a wider audience that may be interested in their services. The

advent of social media has provided businesses with a new way to interact with their customers and potential clients (Alalwan *et al*. 2017).

4.4 Conclusion

The study found that the emergence of Industry 4.0 has influenced accounting practices in different ways. Audits teams can now leverage modern technologies for risk monitoring, identification of fictitious transactions and data analysis for anomaly disclosure. Virtual platforms such as Zoom, Teams, Twitter, WhatsApp, and other related digital platforms have influenced communication with stakeholders, enabling firms to disseminate and compile real-time financial reports. Cloud storage and access allow for almost unlimited storage capacity but also, for instance, access to real-time information for stakeholders. Real-time information allows for proper and effective decision-making that is based on accurate and up-to-date information.

The advent of Industry 4.0 has enabled financial information to be collected and processed in real-time. Results show that the implementation of Industry 4.0 has improved the process of preparing and compiling financial statements, increased efficiency, reduced cost, improved real-time information transfer and storage. Industry 4.0 has brought improvement in data storage capacity in accounting through cloud storage that can accommodate unlimited data at minimal costs. Furthermore, Industry 4.0 has presented accountants with various communication channels they can use to interact with their clients for example, WhatsApp, Twitter, Zoom, MS Teams and other social media platforms. Social media platforms were found to offer accountants an opportunity to market their services to the public because they are cost-effective and offer instant feedback and engagement with clients.

The study showed that pressure from trading partners and other stakeholders had an influence on Industry 4.0 implementation in accounting. It was further found that technological advancement may be stimulated or inhibited by government regulation. Participants further pointed out that pressure from accounting controlling bodies and the government influenced accounting firms to adopt Industry 4.0 for conformity. The resources of an organisation was another factor influencing accountant to adopt Industry 4.0. Financial and human

resources affect the type of technology an organisation adopts. In addition, the size of the business and its processes thereof were another factor influencing Industry 4.0 adoption. In addition, the study found that adopting modern and innovative technologies has largely failed due to organisational culture.

CHAPTER 5. PRESENTION AND DISCUSSION OF FINDINGS-THEME TWO

5.1 Introduction

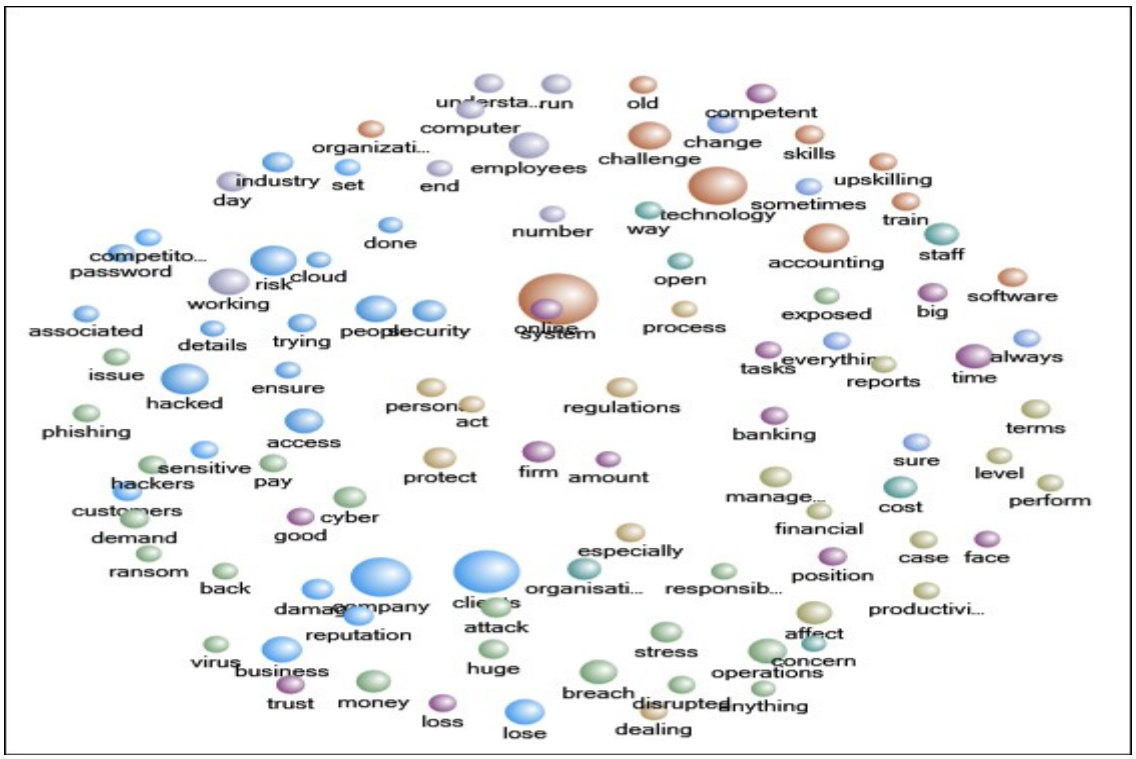
Chapter five presents and discusses the study findings on the challenges and the risks associated with adopting Industry 4.0 technologies in accounting. The research findings are based on the views of the participants related to the challenges and risks associated with Industry 4.0 adoption in accounting. The results show the challenges that accounting firms encounter while implementing Industry 4.0 technology and incorporating it into their existing accounting systems. The results also highlighted the risks of Industry 4.0, such as the possibility of cyberattacks, data privacy issues, data breaches and a lack of standardisation in the industry.

5.2 Theme two: the challenges and risks associated with the adoption of Industry 4.0 in accounting

This key theme was important to ascertain the challenges and risks to accounting firms when embracing Industry 4.0. Figure 5.1and 5.2 Word cloud and cluster analysis that show the words that were mostly spoked by the participants during the interview in terms of the challenges and risks associated with Industry 4.0 adoption in accounting. The larger the font implies the more the word was used and the larger the bubble, the higher frequency of words. This helps to identify key themes. Clients' and employees' resistance, skills and competences, resources, regulations, and cyber-attacks were some of the challenges pointed out by the participants associated with Industry 4.0 adoption. However, hacking, ransom demand, information leak, phishing malware and viruses were some of the risks associated with the implementation of Industry 4.0.

Figure 5. 1 Word cloud

Figure 5. 2 Cluster analysis



5.2.1 Sub-theme 1: Challenges presented by Industry 4.0

The following were seen as the key challenges that hinder the adoption of Industry 4.0 technologies at accounting firms.

5.2.1.1 Resistance to change

Resistance to change will be the main challenge. This is for the following reasons.

5.2.1.1.1 Historical

Historically, staff are accustomed to traditional manual methods and may not embrace new technology easily.

Participant **#2** observed that younger accountants are more likely to welcome the implementation of Industry 4.0 as opposed to their older colleagues.

"It also requires staff to be more open to change you might have a staff member that was trained maybe on a manual system 10 years ago and they are so skilled in that system that when a practice has to move to an automated online cloud based system, it's not easy for them to open up to be retrained and develop a new skill so a few of our staff that are a bit older and are familiar with older outdated system that is still working but they're not really open to change".

Participant **#4** suggests that older accountants may not be open to embrace modern technology.

"…so, there is a lot to do with this migration from the old way of doing things to the new way… so old staff who have always been doing things in the traditional way their whole life and now to change today technologically is a bit of a struggle from a mindset perspective".

Resistance to change was one of the challenges experienced by accounting firms when implementing Industry 4.0. The adoption of Industry 4.0 will be severely hampered by negative employee reactions. The finding is aligned with Rowles and Brown (2017) who found that negative attitude can spread when people do not trust modern technologies. Any technological deployment in the workplace necessitates a number of job adjustments that must be made in order to fully utilise the new technology's capabilities. This could necessitate an adjustment to the accountants' existing routine which could lead to adversarial behaviour. Resistance to change is a crucial component that needs to be taken into account when considering the adoption of new technology and other transformation programmes. Stakeholders' resistance to modern technology

would increase the cost paid by the organisation for the introduction of the technology (Salloum and Al-Emran 2018). Therefore, the organisation needs to first diffuse any resistance from the employees before implementing Industry 4.0. This finding supports the relevance of both the TOE and the Institution theories to understanding the adoption of Industry 4.0 in the accounting sector in South Africa. It suggests that to facilitate the adoption of Industry 4.0, it may be important to address resistance to change within the organisation, perhaps through change management strategies, communication, and training.

5.2.1.1.2 Clients

Some clients may also be reluctant to try modern technology as they may fear the unknown. Some clients may feel unsafe in trusting technology and would prefer manual methods of communication, transactions, and business.

Participant **#9** observed that some clients may resist change as they would prefer to do thing the way they have been doing.

"The clients that I have we are still sticking on the telephone and emails and I think one or two will prefer to have a Zoom meeting… so the other one they would prefer to come the office and have a face to face meeting and then either e-mail or telecommunications but with the Zoom and the other form of communicating it worked during the time of COVID-19 when we were unable to meet clients face to face".

Participant **#10** suggests that the fear of cybercrime may discourage clients from adopting new and innovative technology.

"Another challenge in terms of clients now because to access these things, you might like to link the bank and they would need to log in onto their bank banking apps through their account… so some of them are a bit reluctant to login online because of the history surrounding banking scams, fraud that has been taking place as much as these software's they do a sure and provide assurance that they are secure but you know some clients are still sceptical".

The study reveals that clients can pose a barrier to Industry 4.0 implementation in accounting. Change and transformation are words that usually trigger worry or outright rejection. Moreover, pressure from an organisation's trading partners or

clients can delay the implementation of new technology. This could be due to security and privacy or compatibility concerns. Singh and Hess (2020) explain that businesses are hesitant to start a change initiative if it needs them to persuade their trading partners to transform their process. Changing the way individuals perform a particular task that they have been performing well for a period of time could result in unexpected outcomes.

5.2.1.2 Staff

Staff challenges may revolve around the following.

5.2.1.2.1 Skills and competencies

The skills and competencies will play a role in technology adoption. The lack of such skills can surely hinder its adoption. A system is only as good as its users; hence the system's capabilities may not be realised if staff are not competent at utilising it effectively. The constant evolution of technology is a possible reason for employees losing skills, gaining skills, and changing skills in the workplace.

a) Additional hiring and training

There may be additional hiring of technology-oriented staff and additional training required to build staff skills. This will come at a cost to the firm.

Participant **#6** points out that there is a potential need for accountants to be trained in modern technology, which could pose a challenge to the adoption of Industry 4.0.

"But also, there's also the challenge of employees' competencies, when new technologies are introduced to an organisation there is a potential that an organisation needs to train or hire new individuals to run the system, and this adds to the cost of new technology".

Participant **#8** believes that accountants need new skills to be able to operate Industry 4.0 systems.

"One the challenges of Industry 4.0 on accounting is that the accounting profession needs upskilling to manage data that should be analysed and audited. Data quality and security require special competences and knowledge. The

accounting professional bodies and educators should build such skills through training and education of their graduates".

Participant **#1** also suggests that accountants need to be upskilled in technologies like robotics and artificial intelligence.

"Accountants also need some new skills related to robotics and artificial intelligence to benefit their business and add value. One of the most required skills is machine learning technology expertise, and the depth of knowledge depends on the size of the investment policy and the organisation's innovation strategy".

Participant **#12** explains that employees need to be trained on every technology that the firm intends to introduce.

"Nothing comes without its own challenges for instance, when technology comes in you're not going to have automatic knowledge of that technology so there will be a needed to upskill again which might be the challenge for most of us people who are in our 40s may no longer be willing to spend time again studying and training ourselves but with this technology we have no choice but to upskill so that you can remain irrelevant in your field".

The study shows that lack of skilled staff may pose a challenge to the adoption of Industry 4.0 in accounting. Acquiring new skilled and competent employees will come at a cost to the business. In addition, upskilling and training programmes take employees' time away from production. The finding is corroborated by Wyant and Baek (2019) who reveal that the lack of digital skills might act as an obstacle to the implementation of technology in education. The finding is in contrast with the study by Atkin *et al*. (2017) who did not find any correlation between employee skills and technology adoption. However, businesses that adopt Industry 4.0 must realise that their workers will need to always learn new skills.

The ever-evolving skills raise a number of difficulties for businesses. This new era of technological convergence will require new skills and a new language to leverage the benefits of these innovations and understand the consequences (Skilton and Hovsepian 2018). Given the dynamic nature of the modern

workplace, it is essential that accountants possess a diverse skill set that will allow them to adapt to new situations and overcome challenges they have never faced before. It is difficult to motivate current employees to further their professional development and lead individuals through a process of skill-based transformation when those individuals may be resistant to that change (Goulart, Liboni and Cezarino 2022). Conventional careers and skill sets are coming under increased pressure as a result of the emergence of Industry 4.0. This finding supports the relevance of the TOE Theory to understanding the adoption of Industry 4.0 in the accounting sector in South Africa. It suggests that to facilitate the adoption of Industry 4.0, it may be important to consider the skills of employees and how these can be developed or supplemented. South Africa, like many countries, faces a skills gap in areas such as data science and digital technologies. This means that firms might struggle to find employees with the necessary skills to implement and use Industry 4.0 technologies.

5.2.1.3 Digital realm

There are many challenges that exist in the digital realm. These include,

5.2.1.3.1 Integration

Integration of new systems with the older system can bring about compatibility issues. This can cause errors, delays, disruptions and also staff frustrations. This can also hinder productivity for that time.

Participant **#6** believes that the lack of compatibility between new and old systems presents a challenge in terms of system integration.

"Some of the challenges associated with Industry 4.0 is the compatibility of the new systems or technologies with the old technology… this can be a problem if the new technology cannot be synchronised seamlessly with the old technology".

Participant **#9** explains that a challenge may arise when the old and new systems cannot be integrated which can cause disruptions in production.

"When you are bringing in new systems you have to understand the new system and how it will integrate with the old system because if you make one mistake

then the system will kick you out or freeze… that's why there are still a lot of people still using both old and the new system because they are scared of bringing in new system that may not be compatible with the old and they may find their operations interrupted because of the clash of systems".

This reveals that a lack of compatibility with the existing technology used by the organisation may cause a challenge to Industry 4.0 implementation in accounting. In a related study, Tanner and Richter (2018) found that the adoption of electronic invoices by businesses in Switzerland was hindered by a lack of compatibility with the existing technology employed by the businesses. All operating systems must be compatible with one another for the system to function effectively. Compatibility means that different systems should work together and exchange information and resources effectively. When implementing new technology, precautions must be taken to safeguard the automated system from factors that could trigger a malfunction. It is possible that incompatibility issues will arise between the various communication devices. For instance, the updated software will not work with the clients' existing hardware. This finding supports the relevance of the TOE theory to understanding the adoption of Industry 4.0 in the accounting sector in South Africa. It suggests that to facilitate the adoption of Industry 4.0, it may be important to consider the technological challenges of integration and how these can be effectively managed. The inability to integrate the new technologies with the old hinders the adoption of Industry 4.0 in accounting.

5.2.1.4 Cyber attacks

Cyber-attacks remain an ongoing challenge that can disrupt operations and cost the company money and this will continuously require upgrades to security measures.

Participant **#3** points out that one of the biggest fears of any internet user is the possibility of a cyber-attack.

"We have things like cyberattacks as number one because the more you are exposed to the Internet the more your data or your gadgets are exposed to

fraudsters who can steal your information and use it for their personal benefit to your detriment so that's another huge negative aspect brought by Industry 4.0".

Participant **#9** indicates that accountants are exposed to the risk of being hacked when operating on the internet.

"There is also a risk of your business to be hacked which can shut down all your operation and at the end of the day you will lose money because you can't do anything, and these people might demand ransom for them to return your information".

Cyber-attacks are a major challenge faced by businesses when transacting online. Cyber-attack can have a devastating impact on business. When hackers gain access to the system, they will have the administrative right to alter the network settings that can break the machines. Companies that have been the target of cyber-attacks may experience permanent financial and reputational damage (Agrafiotis *et al*. 2018; Kamiya *et al*. 2018). Cyberattacks have become increasingly prevalent and affect all businesses. As a result, cyber-attacks have rapidly evolved to be among the most pressing risk management concerns for all businesses.

Stealing trade secrets, hacking of computer networks to interrupt service and steal sensitive customer and business information to sell online are all forms of cybercrime. Cyber security and data protection are seen as the essential features for Industry 4.0 implementation (Cagle *et al*. 2020). Businesses that rely heavily on digital technologies to operate and that frequently act as administrators of individuals' information are prime targets for these malicious attacks. The pervasive nature of internet connectivity has exacerbated the security risks faced by electronic systems. The study finding aligns with the technological element in the TOE which suggests that the perceived security risks associated with the new technology could be a significant barrier to the adoption of Industry 4.0. This suggests that to facilitate the adoption of Industry 4.0, it may be important to consider the technological risks, such as cyber-attacks, data breaches and how these can be effectively managed by the accounting firms in South Africa.

5.2.1.5 Resources

Resources can be a hindering challenge (see also listed under Primary Industry 4.0 factors influencing accountants to adopt new technology).

5.2.1.5.1 Financial

Financial challenges can be hindering whereby smaller businesses may not have the adequate budget to invest in new technology and skills thereof.

Participant **#7** highlights that some accounting firms may not be able to afford Industry 4.0 technologies due to financial constraints.

"Yeah obviously these technologies don't come cheap especially for small businesses… for big business I would say it's an expense that can be quite low in their budget sometimes even negligible but for small businesses that are still coming up it can be quite a burden to have all this technology and having to pay for it so in that way… you know even though it is a necessity but also it can mean that the company can incur quite huge costs that might not make it feasible for some small businesses to acquire the technology".

Financial constraints of the business place a challenge to Industry 4.0 adoption by accounting firms. Small accounting firms may find it unfordable to adopt Industry 4.0 because of the financial outflow required to acquire the technology. Moreover, large companies often have a larger quantity of resources accessible to them, which can make the process of technology adoption much simpler. Costs associated with software and training have been highlighted as a major barrier to adopting audit analytics (Li *et al*. 2018). Smaller businesses might only be able to afford the most fundamental features and elementary training programmes, while larger corporations can afford not just the software itself but also training and repair services. Overall, auditing demands are higher at larger companies. Therefore, larger companies are the ones most likely to gain from employing audit analytics.

5.2.1.6 Cost of technology

The cost of technology can be expensive because it entails technology infrastructure, software, support and skills development for staff. All of these costs can outweigh profits.

Participant **#11** elaborates that the cost of upskilling and staff training in addition to the initial amount of acquiring the technology all form part of the implementation and adoption of Industry 4.0.

"When you acquire a particular technology, you will need to train and upskilling your staff because their level knowledge of that technology may not be enough to operate that system… so which means there's a need to train them which is very costly because now we have to pay for these courses that are very expensive to learn the new systems".

Participant **#12** explains that the cost associated with implementing Industry 4.0 requires a large financial outflow.

"We also have business intelligence technology which is software that is used to make decisions, financial planning and forecasting but to have access to this technology will require a business to have a larger capital outlay so smaller and medium companies do not have… but also regulation make these technologies more expensive because now it's an embedded cost of that technology".

The study reveals that the cost of implementing Industry 4.0 remains unfordable for most businesses. One of the disadvantages of specialised audit software is the exorbitant price of the technology, which in some situations necessitates skills beyond the auditor's degree of technical understanding (Aksoy and Gurol 2021). Therefore, there is a significant financial burden associated with the adoption of digital technology. The adoption of Industry 4.0 has hidden costs besides the initial cost of the technology. The hidden cost could be associated with the training of employees, maintenance of the system and cost of security. Moreover, increasing stringent regulations for protecting user data are driving up the cost and difficulty of developing and maintaining software systems. Investing in artificial intelligence remains too costly considering the additional costs of maintenance (Zheng *et al*. 2021). Additionally, Astafeva *et al*. (2019) explain that despite the hefty price tag of introducing the XBRL technology, prominent firms are prepared to spend money on creating software for integrated reporting that satisfies global standards. This indicates that larger firms might have more resources for technology investments and the internal expertise needed to carry out complicated projects. The study finding aligns with the organisation construct

in the TOE which suggests that the adoption of technology is influenced by organisation resources. These factors include aspects such as the financial resources available for technological investment. Therefore, the high cost of Industry 4.0 technologies can be a barrier to adoption, particularly for smaller firms or those with limited resources.

5.2.1.7 Regulatory and legal

The regulatory and legal environment can pose challenges.

5.2.1.7.1 Highly regulated environment

The accounting fraternity is a highly regulated environment. Hence the adoption of technology would have to meet regulatory standards. The regulatory bodies would be stringent on the standardisation of financial reporting. Also, technology and system would need to be in accordance with financial laws.

Participant **#6** believes that regulation may limit the implementation of some new and innovative technologies.

"Accountants operate in a highly regulated environment, and this makes it difficult for accountants to deploy any technology that has not being approved by the controlling or regulatory bodies. This may be the case considering that there is a need for uniformity in reporting of financial information".

Participant **#7** shared similar views on the impact of regulations on the adoption of new technology.

"Regulation do pose a challenge because everything that is coming there's always a risk that the government is also obviously worried even businesses are worried that when something new comes it should not compromise the privacy or will it not compromise the security in terms of securing their data what if it's leaked because we've seen how you know people can hack the systems nowadays and then demand a ransom for it so in terms of those changes I believe it is necessary for government to come with the regulations to make sure that it's properly regulated to cut off those so at least limit them because there's always a risk but at least limit them so sometimes I feel like regulations is red tape but sometimes it's necessary".

Participant **#8** believes that some regulations make it difficult for accountants to adopt new and innovative technologies presented by Industry 4.0.

"One of the major challenges was that accounting had to be done by following uniform methods and rules, and therefore became a challenge but necessary to adapt technology and maintain the basic accounting principles".

Participant **#9** suggests that the lack of consistency in regulations dealing with technology poses a huge challenge towards Industry 4.0 adoption in accounting.

"There is also a problem with the law that keep changing all the time especial the tax laws and you must be up to date with any tax amendments".

Compliance with the legal requirements makes it difficult for accountants to adopt Industry 4.0. The incentives for accounting firms to implement Industry 4.0 is affected by laws. The pace of blockchain technology development may be impacted by legislation and regulations (Janssen *et al*. 2020). Additionally, firms' decisions to utilise cloud computing may be influenced by governmental regulations (Tomás, Thomas and Oliveira 2018). Therefore, implementing Industry 4.0 may be significantly impacted by the effects of current rules and regulations. For example, the Protection of Personal Information Act (POPIA) requirements are stringent and online systems must adhere to the requirements. The act seeks to protect how personal information is accessed and processed by businesses. This can be challenging in ensuring that every requirement is met through an online system. Business organisations are hampered by outdated technical regulations that slow the adoption of modern technologies.

5.2.1.8 Privacy

Electronic systems can be hacked, and private information can be leaked or stolen. Hence additional authentication must be implemented, and this can be challenging to continuously update systems accordingly.

Participant **#3** highlights that some new technologies may present a challenge in terms of privacy.

"There is an issue concerning data privacy because when you are storing your data on the cloud, the question is who is managing your data, how much trust do you have in them as these people can sell your information to your competitors".

Participant **#6** indicates that the adoption of Industry 4.0 may be affected by privacy and security from modern technology.

"There is also a challenge of privacy and security issues associated with Industry 4.0 and this may slow down the deployment of some of these technologies. when you adopt these technologies there is a likelihood that you might be hacked, and this is a significant issue that most organisation view seriously".

Participant **#10** explains that new technologies may pose security and privacy issues which can hinder their implementation.

"…and then another risk is accessibility of data now where anyone with the password and the username can access that data. So as much as we try to set-up additional layers of authentication where there will be two factor authenticators being used but there is that risk where anyone can have access to your information".

Emerging technologies pose a major threat to the privacy and security of organisational data. Concerns over data privacy can undermine the benefits that new technologies promise in terms of efficiency and comfort (Watson 2017). There are increased privacy issues with new technologies due to the systems' continual monitoring and recording of people's communications. There has been a steep rise in the volume of personal information that is being gathered, processed, and stored. Accountants are prone to face privacy issues as a result of Industry 4.0 adoption due to the large volume of information they are processing. The collection of large amounts of data in real-time with technologies like big data, social media, and analytics is likely to increase privacy concerns in accounting. It would be illegal to gather or process any information in a way that goes against privacy regulations. This finding supports the relevance of both the TOE and the Institution theories to understanding the adoption of Industry 4.0 in the accounting sector in South Africa. It suggests that to facilitate the adoption of Industry 4.0, accounting firms must consider the privacy risks and regulatory requirements. South Africa has strict data protection laws, such as the Protection of Personal Information Act (POPIA), which accounting firms must comply with. The threat of privacy breaches and the need to comply with data protection

regulations can present a challenge to the adoption of Industry 4.0 in the accounting sector in South Africa.

5.2.2 Sub-theme 2: Cybersecurity risks and breaches

This primary subtheme established the cybersecurity risks and their implications on the firm and management.

5.2.2.1 Cybersecurity risks associated with Industry 4.0

There were various risks associated with the online world.

5.2.2.1.1 Hacking

Hacking was the most highly ranked risk. This is a logical argument as hacking is seen to be the primary online risk for many online users. Hacking can be done in different ways whereby one could break the security measures, steal usernames and passwords, and disguise themselves as users. Hacking can result in systems being taken over, money and information being stolen, and firms being brought to a halt. It remains a dire risk.

Participant **#1** indicates that cybercrime is one of the major risks faced by firms implementing Industry 4.0.

"I would say that's one of the major cyber security risks is hacking you hear about this almost every day of hackers having access to certain company's information, but it may not necessarily be hacking but employees themselves leaking out information to your competitors that information is critical for your overall survival… therefore organisations need to invest a lot in ensuring that their systems particularly their information is secured such that no unauthorised access is gained by anyone who is outside of that organisation".

Participant **#2** also shared similar views with other participants on the risk of cyber-attack on businesses.

"Definitely the issues of being cyberattacked or hacked".

Participant **#4** suggests that because information is now stored electronically, it creates an opportunity for cybercriminals to access it by using techniques like phishing.

"The first risk arises from a lot of people use laptops and a lot of information being stored in the cloud electronically, the second risk arises from people's phones being linked to their work system. so, the fact that information is stored online means anyone online can hack and get it, so the cyber risk is increased drastically for phishing, scam emails, fake links".

Participant **#7** highlights the danger of cybercriminals hacking into the company's server to steal information and then demand ransom for their return.

"There are criminals everywhere that are trying to hack your system and then demand to release information if you don't pay them, so those things have major consequences when it comes to the new digital age".

Participant **#8** suggest hacking can threaten an organisation's survival.

"Industry 4.0 also comes with challenges. There are many firms that have experienced hacking of essential customer data, and this can be damaging to the company and its customers".

Participant **#9** indicates that the risk associated with conducting business online is cyber criminals.

"One of the biggest risks that have come with these new technologies is the bad guys on the internet I mean hackers at one point my social media account was hacked, and this person".

Participant **#10** also concurs with other participants on the dangers of hacking into the company's server to steal sensitive information.

"Some of the risks here as I had outlined initially obviously now since we are working on a cloud most of the work is done online so there is a lot of security risk now because clients banking details, information about suppliers and other sensitive information about the company could be hacked so you need to ensure that you have proper systems in place".

Participant **#11** explains that there is a danger of cybercriminals trying to steal sensitive information from the organisation.

“With cybersecurity we will be talking about hacking, generally people looking on to your emails maybe trying to figure out your password for certain packages or cloud services if they are managed to get password from your system then they will have access to client’s details”.

Hacking was found to be the major cybersecurity risk associated with Industry 4.0 adoption. Juma'h and Alnsour (2020) point out that businesses largely depend on technology and have inherent technical weaknesses, therefore security breaches and data losses are unavoidable. Data is among the most valuable assets for the firm, and the potential loss of such assets has become a concern for all stakeholders. The risk of hacking and phishing remains regardless of the policies and controls that businesses put in place to reduce the risk of data breaches. The continuity and survival of businesses are influenced by the privacy and security of data. Businesses are implementing a variety of security measures aimed at reducing such risks. Despite these mitigation initiatives, criminals are become more skilled and organised, which increases the threat (Juma'h and Alnsour 2020).

5.2.2.1.2 Phishing

Phishing is also related to hacking whereby it is an attack that attempts to steal money, information, and identity by getting one to reveal their personal information in a deceptive but convincing way. This can render firms vulnerable.

Participant **#5** point out that phishing attack and hacking are risks associated with the adoption of Industry 4.0.

“Phishing attack, risk of being hacked”.

Participant **#7** elaborates that the risk of cybercrime is inherent within Industry 4.0 networks.

“I would say it's basically phishing where I'm working now, they are very concerned about cyber security… I have had to attend courses for almost two weeks just on cybersecurity were they tell you about scams, tailgating and

phishing and there's also different types of phishing where they target the organisation, or they target the individual you know, or they get into the organisation".

Participant **#8** points out that accountants are faced with the challenge of identifying phishing emails that pose a threat to the organisation.

"Phishing is also a significant challenge, you always have emails that appear to be genuine and yet it's meant to cause damage to the firm".

Participant **#10** further explains that phishing emails are a threat to the organisation because they may contain malware.

"There is also the risk of phishing attack were an email can be sent to you with an attachment that seems to be from genuine person or company, but that email has a virus that might affect your system".

The study reveals that phishing is the most popular technique of spreading malware. The user receives an email from fictitious email accounts that appear to be associated with the protected websites. Phishing attacks always aim to obtain financial gain for a third party or causing financial loss to a victim company. A successful phishing attack can tarnish the company's reputation, cause financial lose and disrupt operations. Albladi and Weir (2018) explains that phishing attacks rely heavily on the victim's social connections and level of trust. Users frequently place more trust in sources they believe to be reliable, such as members of social networks, places of employment or family. Therefore, phishing threats often succeed when posing as these trustworthy individuals. Ransomware can infect a computer through phishing emails that host the malware's executable files (Ali 2017). Accounting and financial sectors are the main targets of phishing attacks because they handle clients' sensitive information. For example, banking details, Identity numbers, phone numbers and addresses. The risk of being targeted by a phishing attack is inherent for anybody who uses email. It is important for cyber-security programmes to pay attention to phishing emails because they are the most common ransomware payloads (Nicholson *et al*. 2020).

Rao and Pais (2017) indicate that phishing is a type of cyber-attack that tries to persuade online users to give up their confidential data. For example, passwords, usernames, and banking information. Phishing emails need a combination of emotional and rational feelings for it to be successful at getting people to open them (Nordgren 2018). The most effective method of protecting against phishing is prevention, which may be accomplished through ongoing workplace training (Nordgren 2018). Phishing is an increasing cyberthreat that is difficult to combat (Rao and Pais 2017). Phishing attackers influence their victims to do the dirty work for them instead of initiating a more technical cyberattack (Nordgren 2018).

5.2.2.1.3 Ransom

Companies can be held for ransom by cybercriminals, and they can demand money either is ordinary currency and/or even cryptocurrency such as bitcoins.

Participant **#3** indicates that cybercriminals have a tendency to demand ransom playout from the victim for the release of their data.

"The implications of cyber-attack are huge, once you are attracted by these cyber criminals the first thing they may demand large sums of money to give you back your information but even if they give you back the information there is likelihood that they may have made copies so your confidential information is exposed… say if you are running a company that is built on secret recipe it means that it's gone and your competitors can have access to your secret recipe or patent and other sensitive information therefore you risk losing your business as well".

Participant **#5** points out hackers tend to demand money from their victims.

"At one-point intime our system was hacked, and the hackers were demanding some money but lucky enough our service provider was able to recover our data and there was no need for us to pay".

Participant **#6** explains that hackers extort money from their victims to return their information and access to the organisation's network.

"But also, you may lose you're trading secrets, you've seen companies paying money to get back the information because hackers might demand a ransom for

them to give you back your information… this also translates into a financial loss for the company which is quite a main impact of data breach".

Participant **#8** explains that there is possibility of hackers demanding ransom for the return of the firm's information after a successful cyber-attack.

"Hackers nowadays can hold a company ransom by hacking a firm and demand a large amount of money in return of restoring the hacked system".

The repercussions of a successful phishing assault on a business can be devastating. Cybercriminals tend to demand ransom pay for the return of the company's information. Hackers usually use scare tactics to pressure their victims to pay the ransom. A victim may be sent a message that their information will be deleted or that access will be denied if they don't pay the ransom. Victims are forced to pay hackers a ransom in order to receive the decryption key (Kostopoulos 2017). The victim may not be able to get their data back even after the ransom is paid. Moreover, information is permanently destroyed if the victim does not pay the amount demanded by the cybercriminals because the encryption is difficult to break (Chatterjee *et al*. 2018).

5.2.2.2 Malware and viruses

Malware and viruses can infect systems and cause them to crash and/or malfunction. This can bring operations to a halt and information can also be lost.

Participant **#2** points out that phishing and malware are threats inherent in the technology realm.

"malware and phishing are the bad side of technology".

Participant **#5** suggests that hackers plant malware to steal sensitive information from the firm.

"malware can be sent to your network to steal information, so you need to ensure that firewalls are actively working".

Participant **#6** suggests that with traditional paper-based documentation it would be difficult for systems to disrupted because of malware.

“There's also concern about viruses you find that you might have a virus in your system that affects your system and corrupts all your files whereby you can’t do anything…traditionally when you use paper it's impossible to have a situation where one controls your system”.

Participant **#10** explains that viruses and cyber-attacks are risks associated with Industry 4.0.

“The darkest side of these technologies is the viruses and cyber-attacks”.

Malware and virus were found to be among the risks associated with the adoption of Industry 4.0 in accounting. Malware is still the most popular method used to break into a system and steal sensitive data (Gofman *et al*. 2021). The current versions of malware attacks are increasingly sophisticated and hard to detect. Accountants can unknowingly spread malware when they click on seemingly safe links. A malware attack is an undesirable occurrence that has a detrimental effect on a firm's operations and processes. Damage to information systems can involve rendering information unusable, deletion, tampering of data and denial of service.

5.2.2.3 Information leak

Intentional and unintentional information leaks can cost firms lots of money, especially if this information is given to competitors. It can also damage the reputation and trust of clients.

Participant **#1** indicates that sensitive information can easily be leaked to the company’s competitors in a technological arena which could threaten the survival of the firm.

“Leaking out information to your competitors that information is critical for your overall survival therefore organisations need to invest a lot in ensuring that their systems particularly their information is secured such that no unauthorised access is gained by anyone who is outside of that organisation”.

Participant **#6** indicates that the risk of data leak could be orchestrated by an individual within the organisation.

“Sometimes it could be even just an employee who might be negligent by leaking company’s’ information out”.

Participant **#11** explains there is a risk of customers' personal data being fraudulently obtained by cybercriminals.

“Imagine if its online store which means that they are going to take all customers sensitive information, banking information like credit card numbers and this information can be sold in the black market for their own benefit like committing fraud”.

The study revealed that there is a risk of employees leaking confidential information in the advent of Industry 4.0. Any leak of sensitive information might have far-reaching consequences for both the company and its clients. Data leaks frequently have an adverse effect on business activities, and in certain cases, they result in expenses for public relations responses and revenue loss. Cheng, Liu and Yao (2017) indicate that a firm’s information can become compromised both internally and externally which could be done on purpose or accidentally. Therefore, a firm's long-term sustainability may be compromised if confidential data is leaked. For instance, data leaking can occur due to data theft carried out by hackers or sabotage carried out by an employee within the organisation. It is possible for data leakage to occur when staff unintentionally shares confidential information. In the era of Industry 4.0, it can be difficult for businesses to eliminate data leaks.

5.2.3 5.2.3 Sub-theme 3: Implications of breaches on firms

Breaches can have severe implications for the firm. These are classified below.

5.2.3.1 Economic

Economic implications were the most highly ranked. This was a logical finding. It consisted of the following. The study finding aligns with both TOE and Institution theories. It suggests that to mitigate the risk of financial loss, it may be important for accountants to consider the cybersecurity risks associated with Industry 4.0 and the regulatory requirements around data protection.

a) Financial

Financial implications would be severe for the firm in the following ways.

- **Loss of customers**

The business can lose customers as they will lose confidence in the firm. This will also lead to a loss of income.

Participant **#2** explains that a firm can loss clients due to a cyber-attack on the business.

"There is also the possibility of loss of income especially when you cannot serve your clients because the system is down so clients can go to the next door but also the hackers may demand ransom for the return of your information".

Participant **#9** suggests that data breaches might be seen by clients as a weakness in the firm's ability to protect their information and may decide not to do business with the company any further.

"…and this translates to money because you are unable to help your clients and they may walk away but to add on that you are going to lose clients".

Participant **#11** points out that the inability to service clients may cause a business to lose revenue, as customers might terminate any business dealing with the firm.

"But there will less trust and loss of trust is not good for the organisation because any other mistake that you are going to make the client will leave this directly translate to lose of revenue for the business which in the end filters to the workers as you might have to reduce the work force to remain afloat".

The finding reveals that accounting firms can lose customers because of cybersecurity breaches. Customers may lose confidence in the firm's ability to protect their information which can lead to loss of income. The company's clients are also affected when a business experiences a cybersecurity breach. Nguyen, Rosoff and John (2017) indicate that a firm's image and revenue stream can be affected if clients lose confidence because of the data breach. Moreover, customers might advise their colleagues to boycott the company altogether. In

addition, most clients whose data is compromised must constantly be on the lookout for signs of fraud. People's decisions and attitudes can be influenced due to the fear of being a victim of crime (Bada and Nurse 2020). Therefore, firms' loss of customers could be related to clients' fear of becoming victims of cyber-crime.

- **Loss of sales and income**

The loss of customers will lead to the loss of current and potentially new sales, which translates into a loss of income.

Participant **#1** explains that firms may lose revenue due to the inability to process customers' orders during cyber-attack.

"And you are likely to lose on sales because you will not be able to process customers' orders on time and your records would probably be distorted or completely destroyed".

Participant **#6** elaborates that when the firm experiences a data breach, they may be unable to access the company's systems which can cause customers to lose trust in the business.

"So, which means you cannot do any business transaction therefore you are going to lose revenue as you won't be in position to make any money and when you cannot make any money as a result of that you might lose clients because they are not getting any service from you".

Accounting firms lose sales and revenue due to the disruption of businesses' operations because of a cybersecurity breach. The denial of service by hackers means that the firm cannot transact with its clients. Agrafiotis *et al*. (2018) explain that any loss of sensitive information can have far-reaching consequences for a business, including increased expenditures for public relations response and potential revenue loss. Additionally, companies that experience data breaches are expected to suffer significant financial losses (Sen and Borle 2015; Kuipers and Schonheit 2022). These losses include the price of replacing damaged equipment, the cost of restoring consumer trust and litigation costs. In addition,

the inability of a firm to process clients' orders in time can influence customers to opt for another service provider leading to a loss of revenue.

- **Ransom**

Ransom demands can also lead to firms losing money in paying the ransom.

Participant **#8** indicates that ransom demand seems to be a common occurrence when hackers take control of the company system.

"Hackers nowadays can hold a company ransom by hacking a firm and demand a large amount of money in return of restoring the hacked system".

Hackers may demand that a firm pay a certain amount of money for the release of their information. The payment for the release of business information leads to firms losing money. Cybercriminals are now focusing their attention on huge corporations because of the greater likelihood that they will be able to meet the ransom demands (Brewer, 2017). Moreover, some companies would be prepared to pay for access to their sensitive information.

- **Replacement costs**

The replacement of new equipment and software will lead to added costs and revenue loss.

Participant **#6** indicates that businesses that have fallen victim to a data breach may incur costs to replace a damaged system.

"Then you might need to also to replace some of the damaged equipment or you must buy a new software, or you have to hire somebody to come and sort out the mess which is also an additional cost to the company".

Participant **#12** concurs with participant **#6** on the recovery costs after data breach.

"There are also costs associated with replacing any damaged equipment because probably the virus or malware that has been put on your system now you can no longer use that system and you need to replace that system… so that's going to cost so much money".

The business will incur the costs of replacing computers affected by the malware. In addition, firms may need to hire an expert to clean their system which is an added expense that the business incurs as a result of a cybersecurity breach. The costs associated with physical damages to the system as well as the costs of responding to incidents are usually ignored by the businesses. The network system could sustain damage from continued attacks from cybercriminals (Wang *et al*. 2018). Attacks on computer networks can also damage computer hardware and software. Cyberattacks can sometimes have physical ramifications. For example, Stuxnet malware which is blamed for damaging hundreds of Iranian nuclear centrifuges in 2010. If improper instructions are given to an automated system, the system may perform an incorrect action, which may result in waste or damage to equipment (De Smidt and Botzen 2018). Therefore, the cost of replacement or repair of damaged equipment will be an added expense from cyber-attack on the business.

b) Reputation

The firm will suffer reputational damage whereby stakeholders will have a negative view of the firm. The media may also tarnish the reputation further. Reputational damage can lead to further income losses. All stakeholders will wish to avoid the organisation which can lead to isolation and further financial losses.

Participant **#2** explains that the organisation reputation may be damaged as result of data breach.

"And this may damage your reputation with clients and suppliers… you don't want to be in a position where you are telling a client that someone has access to their company information".

Participant **#3** suggests that business' reputation may be damaged if they cannot service their customers due to data breaches.

"When cyber-criminals take your data, it means that you don't have access to your system therefore you don't have access to your customers, creditors and other stakeholder they are now withholding that data until you pay them… so the

costs associated with that to your business is huge and even your reputation will be at stake".

Participant **#9** believes that some clients may lose trust in the company's ability to keep their information safe.

"So, I also think there's a reputation risk some clients are going to have less confidence in your ability to protect their information".

Participant **#7** suggests that clients may not be willing to conduct business with a business that has experienced a data breach.

"To tell the client that our systems have been breached especially if you hold sensitive information about big clients and they can be information that even affects governments… so that could mean the end of the company and once you have that your reputation is damaged no one would want to touch you again".

Participant NK had a different view on the impact of a data breach on the company's reputation. She believes that the good rapport that she has built with her clients will not be affected by a data breach.

"But I don't think I will lose clients because I will explain to them that it was not the company's fault because I have a good reputation with my clients and I believe they will understand that hacking is happening everywhere maybe this was just an accident, what is important is to build trust between the company and the clients so that they know how we deal with our clients… but you might have to spends more money for the IT expert to set up systems again and replace if any was damaged".

Damage to an organisation's reputation is another possible outcome of a data breach in an accounting firm. Marotta *et al*. (2017) found that thirty percent of businesses surveyed ranked damage to their public image and reputation as their main internal worry about cybersecurity breaches. An organisation can lose a competitive advantage when its reputation is damaged. It is possible that the company will suffer a loss of competitive edge as well as damage to its financial affairs and reputation. Alashi and Badi (2020) reveal that the possible repercussions of a cybersecurity breach include damage to the company's image

as well as a decline in its finances and competitive advantage. Therefore, a company's good name is a valuable intangible asset that must be protected.

5.2.3.2 Clients

The implication from a client's perspective can affect the firm considerably.

a) Client loss

As mentioned in other themes, this was a recurring theme, as client loss is almost inevitable. Clients will inevitably lose trust and confidence thus causing them to leave the firm and seek services elsewhere.

Participant **#1** explains that it may reflect badly on the firm when they cannot process client orders due to disruptions caused by a data breach.

"At the end of the day, it also affects your reputation as a business especially when clients orders are not met because operations have been disrupted then it has a very bad image on your organisation, and you might lose that client".

Participant **#6** believes clients may lose confidence in the organisation's ability to protect their data.

"…see but now when this happens also it might damage your reputation as a company because there now clients or customers who will be scared of doing business with you thinking that you're not responsible with their information and they may accuse you of negligence in a sense that you don't put good protective measures to protect their information".

Participant **#11** elaborates that losing clients' sensitive information may cause the clients to stop doing business with the affected firm.

"Information breach on the accounting firm can cause a lot of stress and anxiety on the entire team because you think that should this get into the ears of the client, they may withdraw their business from us and if we lose clients which means that we might stop operating that's how sensitive it is… also the other things is client might be willing to continue working with you".

Participant **#12** concurs with other participants on the impact of a data breach on the company's reputation.

"When this happens, it might damage the company's reputation, and this may drive customers away".

The inability to process clients' orders in time can cause a lot of inconvenience for clients who might seek help from other service providers. A company can suffer far-reaching repercussions because of unfavourable customer experiences. It is probable that investors will react more negatively to an established company in the wake of a data breach because of its reputation (Lending, Minnick and Schorno 2018). Clients will inevitably move elsewhere when a firm is unable to meet their demands. Therefore, a firm will lose its competitive advantage and reputation due to poor service. This can be exacerbated by bad reviews about the organisation. The findings align with Institution theory which posits that organisational decisions are influenced by institutional pressures, which can be regulatory, normative, or cognitive (DiMaggio and Powell 1983). Regulatory pressures include formal rules, laws, and regulations that organisations must comply with. In the context of cybersecurity breaches, these could include regulations around data protection and the financial penalties associated with breaches. South Africa has strict data protection laws, such as the Protection of Personal Information Act (POPIA), which accounting firms must comply with. Non-compliance can lead to significant financial penalties, adding to the financial loss caused by a cybersecurity breach.

b) Legal action

Relating to the above, some clients may become frustrated and upset at the risks caused to them by the breach, and they can resort to legal action against the company. This can lead to further reputational damage and financial losses.

Participant **#2** indicates that unhappy clients may take legal action against the company upon learning about the data breach.

"Also, some clients may institute legal claim against the company when something like this happens but as professionals, we do have professional indemnity insurance with some of our bodies that we registered with so there's always an opportunity for a client to seek legal action against us".

Participant **#4** suggests that investigations by law enforcement agencies and fines can affect the business.

"prolonged investigations from the authorities affects business or you could get a fine big enough that you close down".

Participant **#6** explains that a company may incur legal costs for defending itself against unhappy clients after a data breach.

"Clients might also bring in lawsuits which is also an added cost to the company because now you have to defend yourself in the court of law or you might have to pay damages to your clients because their information has been leaked out".

Participant **#7** believes that the leak of clients' confidential information may prompt an investigation from the authorities and possible prosecution if they find that the company was negligent in protecting the client's data.

"But the implications are that leak of client information can result in lawsuits and investigations by the government".

Participant **#11** also believes that clients whose data was leaked can seek legal recourse against the company.

"And some clients whose data was compromised might institute legal action against the company, but this is not common as for now, but legal representation further inflicts financial cost to the company".

Participant **#12** further elaborates that litigation by clients adds extra expense to the company.

"Because of the interface between your organisation and the server you are most likely to have hackers trying to access your information. Data breach may lead into litigation as clients may open case against the organisation whether you win or lose the case, but you would have incurred these costs also data breaches that affects government information can be very costly and may attract a huge penalty and sanctions".

Clients whose data was compromised might institute legal action against the company. A firm may face legal action from clients because of a cybersecurity breach. Lozada (2020) found that often victims of cybercrime tend to sue the firm

that failed to adequately protect their information because they are unable to identify the perpetrators. It can be expensive to defend against a class action lawsuit filed by several angry clients (Kostadinov 2016). Legal action by clients puts an extra financial burden on the affected institution. Therefore, firms collecting personal information need to put in additional resources to ensure the safety of sensitive data.

c) Trust

Once client trust is lost, it can be very difficult to regain.

Participant **#6** believes that when clients lose trust in the organisation can cause clients not to do business with the affected firm.

"Who would trust you with their information and that would also mean clients leaving you because they can't trust you which translates to loss of revenue".

Participant **#8** explains that it is difficult to regain customers' trust when it is lost especially after a data breach.

"If customers lose trust, it takes a long time to regain their trust again. Moreover, the firm may potentially lose customers if they feel that keeping their sensitive information is not doing enough to protect them from hacking".

Participant **#11** maintains that there will less trust between clients and the organisation after a data breach.

"But there will be less trust and loss of trust which is not good for the organisation because any other mistake that you are going to make the client will leave".

Data leaks affect the relationship between the firm and clients by weakening clients' trust in the company. Individuals' loyalty to a certain firm or brand is founded on trust. Rasoulian *et al*. (2017) suggest that it is challenging for businesses to regain their customers' trust and maintain their brand's integrity following a data breach. In addition, customers may perceive a data breach as a betrayal of their trust as well as a failure by the organisation to provide a high level of service (Rajgopal and Gezer 2019). As a result, customers may develop a negative impression of the firm because of the data breach and may lose loyalty to the business. Being known to be trustworthy is a crucial advantage for every

business. Moreover, the breach of clients' trust has repercussions that are detrimental to the relationship that exists among firms and their clients.

5.2.3.3 Operational

Operational implications can come in the following ways.

a) Disruptions

When an organisation runs primarily on systems, systems failure through cyber breaches can cause major operation disruptions. Operational disruptions to processes will cause delays which is a loss of time and will inevitably translate into loss of money.

Participant **#3** suggests that business operations will be affected by a cybersecurity breach.

"So, being hacked or cyber attacked is not an issue that can be taken lightly in addition, there will be huge disruptions in your operations whereby you may need to reconfigure your operations which also costs money, and it takes time".

Participant **#5** suggests that organisations will not be able to access its information as they may be affected by malware, thereby affecting its operations.

"And when this happens it disrupts operations because you don't have access to your system and information".

Participant **#6** highlights that cyber-attack can affect many organisations in the same network and disrupt their operations.

"This attack could happen from one company, and it can affect the whole network if you have maybe a chain of companies, so you find that you won't be in position to transact or do anything not until that issue is solved and the system is restored".

Participant **#7** elaborates that business might be disrupted when system is shut to contain the spread of the attack.

"This can disrupt the firm's operations because it leads to systems shut down until the problem is resolved. The shutdown of the system in turn severely affect production and revenue is lost".

Participant **#9** explains that business operations may be disrupted due to corrupted files from malware.

"I think on the implications of data breach the company's operations will be disrupted because you will not be able to do anything as the files and system will be corrupted".

Data breach does cause operational disruptions to processes. Lange and Burger (2017) show that a data breach can result in significant disruptions to a company's operations as well as potential drops in income due to the loss of clients. It is likely that a data breach may cause delays in service and decreased output. Therefore, the survival of any company is jeopardised by incidents of data breaches. The main objective of cybercriminals is to disruption firms' operations and steal confidential information.

b) Standstill

The operational disruptions can render a firm to a standstill especially when critical systems are affected that deal with processes that involve orders, transactions and other related. Hence having a manual process to fall back on is still needed.

Participant **#1** indicates that when hackers take control of the organisation's system it brings everything to a standstill.

"If your business gets hacked, you may need to shut down the system to limit the spread of the attack… and at this time your operations will be at a standstill therefore you would have lost on time because the system is off or now you have to implement a manual system".

Participant **#2** suggests that cyber-attack can bring the company to a grinding halt.

"When your business experiences a cybersecurity breach you cannot operate… therefore there is going to be loss of revenue because your operations have been disrupted because the system is down, and you can't process any orders or invoice clients".

Participant **#6** believes that the organisation may be unable to access its systems after the cyber-attack.

"Cyber security breach has a disastrous impact on a business, take for example when you are hacked or when you experience a cyber-attack or data breach first of all your operations get disrupted you won't be in position to do anything because you find that these guys have locked up all your information and your access to your system".

When cybersecurity incident happens, businesses tend to shut down all operations. Organisations commonly employ this strategy to minimise the spread of the attack. Cybercriminals pose a threat to Industry 4.0 systems and networks which might result in interruptions of operations or even complete shutdowns (Berkman *et al*. 2018). In addition, Industry 4.0 network could be compromised by negligent employees.

5.2.3.4 Staff

There are various implications for staff as well.

a) Stress

Employee stress can increase as they will feel as if they could have been the cause of the problem. They may also feel that their jobs and salaries are at stake due to the company's financial losses caused by the breach. This can lead to added stress and low productivity.

Participant **#9** explains that victims of cyber-attack experience stress.

"So, if the office would be hacked then that means we are messed up because you will be stressing all the time as you will not be able to do any work but also when the system is down… definitely you will not be able to generate any income which means the company will not be in a position to meets it obligations like staff salaries".

Participant **#12** suggests that accountants may experience stress when a company is attacked by cybercriminals.

"If we pay huge fines employees are not going to be proud of the organisation that they're working for but there's also a possibility of conflicts amongst

employees, but also maybe the company might be struggling financially as result of the attack employees' salaries might be reduced, maybe no promotion for the next year, no salary increases, or the overtime might be cut-off so this has ripple effect to all stakeholders".

The inability to access business information and even personal data would considerably exacerbate the level of stress and worry experienced by employees. Individuals may suffer psychological trauma even if their personal information is never misused. The victim of a cyber-attack may experience anger. In other circumstances, victims whose data has been breached could even place the responsibility on themselves and feel ashamed (Nurse 2018). Stigmatisation may result from a cyberattack, particularly if there is a financial loss (Modic 2022). Victims of fraud usually regard the emotional effect as being higher than the monetary loss (Modic and Anderson 2015; Modic 2022). Stress induced by cyber-attack can affect employees' productivity and morale as they worry about the future of the business.

b) Employee effect and morale

In relation to the above, staff morale can be dampened as they may feel that their jobs may be at stake and the loss of client trust in their competence.

Participant **#13** explains that employee's morale is affected when the company experience's cyber-attack.

"Staff morale because of the uncertainty surrounding the going concern of the business the other thing is stolen data will be used against the clients whereby money can be taken from their accounts or information may be used to for fraudulent activities either way the incident is going to affect the client and the company which makes us to stress and anxious".

Participant **#12** suggests that management will be under pressure to get the company back to its normal operations.

"There is going to be the pressure on the management because you are the people seated on the driver's seat so there's going to be a lot of stress in trying to steer the company back into the right direction and also there's going to be employees who are going to be demotivated or demoralised".

The worry about their jobs and the future of the firm may diminish staff morale. A decrease in morale can make employees less focused and unhappy, which affects productivity. Employee morale and retention may suffer because of heightened media attention and the company's apparent complicity in the data breach (Schlackl, Link and Hoehle 2022). In addition to financial losses, data breaches can affect a firm by rendering its systems useless, decrease employee morale, and waste staff time. The denial of service of the network will lead to clients moving to other service providers which may force an organisation to cut the number of employees to remain afloat. The worry of being made redundant and possibly jobless affects employees' morale.

5.2.4 Sub-theme 4: Implications of breaches on management-leadership

Similarly, breaches can have implications on management and leadership.

5.2.4.1 Productivity

It would definitely have an impact on the productivity of the leadership. The breach will cause disruptions and loss to the firm which is led by the manager/leader. This will cause added pressure as they will try to focus on the breach and dedicate resources and time towards that rather than anything else and this can lead to loss of productivity.

Participant **#1** believes that dealing with a data breach for the first time may be challenging and stressful for the organisation's leadership which can affect their productivity.

"If this happens for the first time because you may not know how best to handle this matter as a human being your level of productivity can be affected and if you are not careful… you are bound to make a lot of mistakes and make things even worse. if you are working in financial reporting it can affect even the reports that you produce".

Participant **#2** points out that leadership may experience anxiety when dealing with data breaches and this diverts their attention from other duties.

"Anxiety lower productivity for sure because your mind is so focused now trying to fix the problem".

Participant **#3** highlights that management may shift their attention on getting the company to operate and they may neglect other duties.

"When a data breach happens in your company your focus will be finding a way on how to get the company operational therefore you will not be thinking of anything else other than rebuilding this new system… so definitely it will affect you in terms of your ability to perform other duties".

Participant **#5** believes that managers may not perform at their best when they are stressed.

"A data breach will make you anxious and distressed and you cannot perform your duties when you are in this kind of state. I would say productivity would be zero and this can also have an extended impact on your family and friends because you cannot be yourself especially if an investigation has been instituted".

Participant **#6** suggests that productivity will be affected due to lack of access to the system.

"When you're attacked all your systems go down which means there is no productivity… then when there's no productivity you won't be in position to service your clients therefore you will be losing money".

Participant **#7** believes that mangers may be worried about the future of their jobs especially if there is an investigation after data breach which impairs their ability to execute their duties.

"I have seen in many cases where once management takes the heat they just resign and go elsewhere… so those are the implications that can actually happen. Just being in that space where you are constantly worrying about these things can also affect you psychologically and it can make you unproductivity".

Process outage and production shutdown caused by a data breach has a phycological impact on firm's leadership. Firms' leadership may neglect other duties while dealing with data breach crisis thereby affecting productivity. Their attention could be shifted to restore the system to normality. In addition, external pressure may be exerted on management to have the incidents resolved quicker

which could exacerbate the stress levels on management causing them to think irrationally. When confronted with challenging situations, people not only suffer from stress, but they also experience a decrease in productivity (Schlackl, Link and Hoehle 2022). Individuals tend to react to incidents with stress and may avoid having any contact with other individuals if they believe they are unable to effectively exert control over possible threats (Bada and Nurse 2020). Therefore, the motivation and confidence of the manager may diminish.

5.2.4.2 Stress

It will cause tremendous stress on the management as the losses and reputational damage will affect the firm significantly. They would also have to be able to explain the breach to the Boards and provide alternative solutions/recovery plans. This can add to much stress.

Participant **#2** suggests that the pressure on management to get the company back to normality increases stress levels on the firm leadership.

"Number one would be stress I mean as management you are the face of the organisation and clients would want to know why, how this happened and how you're going to fix it…so definitely stress".

Participant **#13** believes that demand for action against data breach may cause stress on the firm leadership.

"I know from our board members have been worried if we are ready to deal with cyber security breach because if we lose clients information we may get sued… and we lose a lot of money out of that so if the breach happens you will be under a lot of stress to explain to the board and maybe law enforcement authority's on how it happened".

Participant **#6** elaborates that the worry about the potential loss of clients due to data breach increases the stress levels of the management.

"when you encounter a cyber-attack or data breach you will not sleep because you as a leader of that organisation has the responsibility to ensure that everything is restored to normalcy so, that comes with a huge amount of stress".

Participant **#7** explains that dealing with a data breach can be a stressful matter which can even affect your relationship with family and friends.

"They are paid a lot of money so that they make sure these things like this don't happen so, if they do happen you have to take responsibility so management responsibility now comes into play and that can obviously have a huge strain on your family and your work environment".

Dealing with the aftermath of cyberattack can be a very traumatic and stressful experience on management. This may entail responding to queries from the media, employees, government agencies and other stakeholder who would be seeking answers from the organisation. Cybercrime has become an increasing worry for business executives as they face increasing pressure from regulators to address cybersecurity threats. Nurse, Creese and De Roure (2017) explain that managers may experience anxiety when dealing with data breach as a result of making certain decision because of uncertainty regarding the potential outcomes of such choices. Aboujaoude (2019) points out that people whose personal data has been compromised can experience anxiety, depression, and post-traumatic stress disorder because of the exposure. Therefore, dealing with the aftermath of cyberattack has psychological impact on firms' leadership.

5.2.4.3 Dismissal and resignation

Managers can end up losing their jobs or chose to resign due to the added pressure and stress.

Participant **#13** suggests that fallout after a data breach may cause managers to resign or their contracts get terminated.

"I have heard situations where some people have been forced to resign from their position because there was a data breach maybe they did not do what they're supposed to do, and this can be traumatising if you faced with that kind of situation".

Participant **#9** reckons that managers may lose their jobs after data breach.

"and you could possibly lose your job".

Participant **#5** indicates that managers worry about the consequence of any investigation after a data breach.

"If this happens the big worry would be how will that affect you… if it's found that you didn't do the right thing to protect client's information, so the big question will be am I go to jail, lose my job or assets so this makes you anxious and distressed and you cannot perform your duties when you are in this kind of state".

Managers may decide to step down voluntarily or could be forced to resign due to data breaches. Moreover, managers may not be able to handle the amount of pressure exerted on them and end up resining. The criticism could come from the media and other stakeholders who may blame the organisation leadership for not doing enough to protect clients' information. Fuhrmans (2017:1) states that "cyber threats have zoomed to the top of chief executives' worry lists for fear a data breach could cost them their jobs and take down their businesses." The fear could be associated with financial and reputation damage caused by data breaches on firms.

5.2.4.4 Media

The media can also create a negative image of the situation and the firm.

Participant MB points out that the responsibility of dealing with the media rests on the firm's leadership and this may increase stress and anxiety on the management.

"When a data breach happens it's always the top guys that have to take the fall, so they are the ones that have to manage the flow information, have to deal with the media and have to explain to the staff basically the reason".

The firm's leadership must manage the heightened negative media coverage of the incident which puts more strain on managers and damage their reputation. Therefore, a good risk communication strategy from the management about data breach can ease public worry and fear. Shareholders may react differently to the announcement of data breach depending on the language and tone used in various media sources (Wang, Ulmer and Kannan 2017). Business leaders may be forced to apologies to its clients' and affected parties for the data breach. Moreover, apology compels the company to publicly acknowledge wrongdoing

for the data breach, which may invite legal action and weakens the company's defence in the case of litigation. However, it has been demonstrated that restoring confidence is more challenging when the issue is one of honesty rather than skill (Ferrin *et al*. 2018). Financial and legal obligations may result from remedial efforts, including compensation.

5.3 Conclusion

Accountants revealed some challenges associated with Industry 4.0 adoption. Findings show that resistance to change from employees and other stakeholders presents a challenge towards Industry 4.0 adoption. Cyber-attacks on accounting firms was found to be another challenge faced by firms when implementing Industry 4.0. Scant resources and the lack of skilled staff were the challenges experienced by accounting firms when implementing Industry 4.0. The study found various risks associated with Industry 4.0 implementation in accounting of which hacking is a major cybersecurity risk associated with Industry 4.0 adoption along with phishing, malware and virus respectively. Also, there is a risk of employees leaking confidential information.

CHAPTER 6. PRESENTATION AND DISCUSSION OF FINDINGS-THEME THREE

6.1 Introduction

This chapter presents and discusses results on the role of management in implementing Industry 4.0 and how accounting firms are responding to cybersecurity threats presented by Industry 4.0. The results reveal how management behaviour and practices influence the implementation of Industry 4.0 initiatives within accounting firms. The results also show the difficulties accounting firms experience in navigating this complicated and quickly changing technological environment, as well as the methods managers are using to deal with these difficulties. The presentation, interpretation and discussion of the results in this section provide a rich and insightful outlook on the role of management in Industry 4.0 adoption and highlights different ways in which businesses can successfully use technology to enhance operations and maintain competitiveness in a contemporary business environment. In addition, the chapter also presents and discusses how accounting firms are responding to the threats of cybersecurity after implementing Industry 4.0. The results provide insights on the measures used by firms to reduce the risks of data security breaches.

6.2 Theme three: the role of management in implementing Industry 4.0 and the responses of accounting firms to cybersecurity risks.

Figure 6.1 word tree showing the words that were often mentioned by the participants regarding the roles of management in implementing Industry 4.0, and how accountants are responding to and recovering from data breaches. Larger blocks indicate how the words were frequently used. Participants often indicated that it is the responsibility of firm leadership to draft and communicate any changes to the employees. Moreover, backup, training and passwords were commonly cited as the most effective techniques of responding to and recovering from a data breach.

Figure 6. 1 Word tree

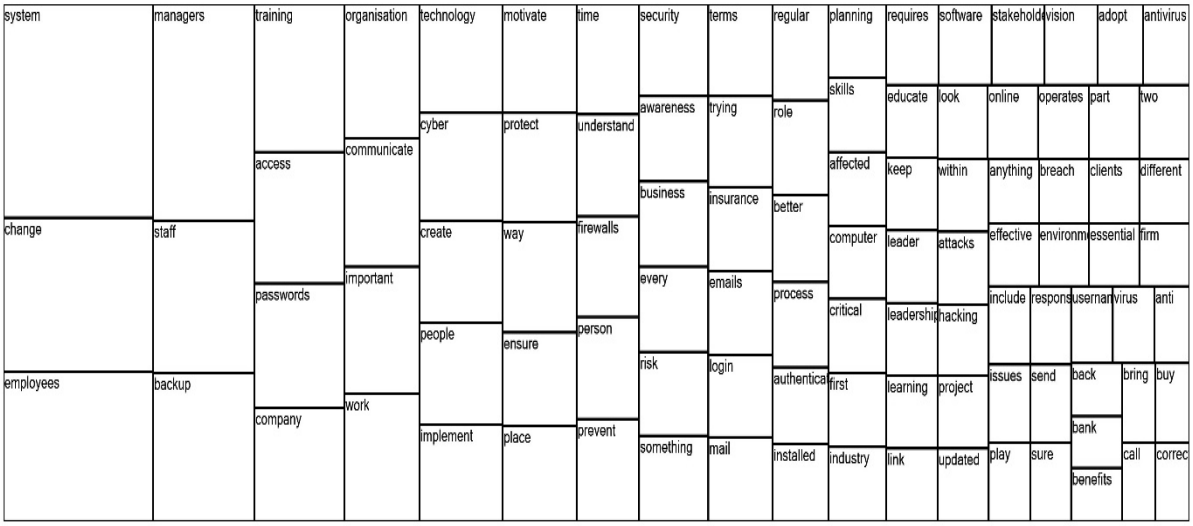


Figure 6.2 word cloud indicating the role of management in Industry 4.0 adoption. Additionally, the figure shows most of the words that participants cited as the main techniques' accountants can employ to respond to and recover from data breaches. The larger the font implies the more the word was used. Participants revealed that it's the role of firm leadership to develop and communicate any changes to the employees and other stakeholders. Moreover, participants pointed out that backup, training and passwords as the most effective way of responding to and recovering from a data breach.

Figure 6. 2 Word cloud

6.2.1 Sub-theme 1: Management role in implementing Industry 4.0 technologies

Implementing Industry 4.0 technologies cannot happen automatically. It is usually up to the management and leadership to ensure implementation is done the 'correct way'. This is informed by the below.

6.2.1.1 Change management

Change management is pertinent but it is dependent on the following factors.

6.2.1.1.1 Communication

Communication was key to change management. Change could not occur if it was not communicated properly and accordingly.

a) Vision and goals vs change

The management must start by communicating the Industry 4.0 vision and goals to staff and stakeholders to get them to understand the reasons and attain a collective agreement. Thereafter change management plans must be aligned to the collective vision and goals.

Participant **#1** elaborates that it is the responsibility of firm leadership to draft and communicate any changes to the employees and other parties that may be affected by the proposed changes.

"So, the leadership has to communicate the changes or the message down the value chain of the organisation so that it is clearly understood by every individual. Organisation is like a bicycle with pedals, wheels and handles so all these things they work towards getting whoever is riding that bicycle towards their destination…so each employee is working in their specific department contributing to the overall goal of that organisation and that can only be achieved if that is communicated correctly by management and leadership".

Participant **#5** explains that management should correctly communicate to the employees how the adoption of Industry 4.0 will affect firm operations and structure.

"The biggest one especially for readership is to communicate how exactly the adoption of these new technologies will impact on the organisation operations and structure because a lot of people are concerned that implementation of Industry 4.0 technologies is going to replace a lot of people and take people jobs… so I think leadership leaders need to make sure that there must be the correct communication… sometimes communication is done but it's not the correct communication, but if the communication is correct it makes the change management process easier".

Participant **#6** suggests that the onus rests on the management to draft and communicate changes and visions to the employees.

"It is the responsibility of the management to draft vision of the organisation and communicate this vision and changes to all employees".

Participant **#8** believes that management should be at the forefront of any change initiative.

"Management also plays a crucial role in communicating change, they should encourage the culture of change. Industry 4.0 requires a fundamental change in the way the firm operates, and it affects almost all the functions of a firm. It is thus, crucial for managers to also understand the fundamentals of change management".

For change to be successful, firms' leadership needs to articulate the vision and set of objectives so that every employee in the company understands what they should be working for. Its therefore critical for management to effectively communicate these changes to all employees and stakeholders of the organisation. Thus, management needs to communicate to all stakeholders on how the adoption of Industry 4.0 will be implemented (incremental or radical), how the implementation will affect them, which employees will be affected and the anticipated result of the change. Among the most important aspects of successful change management is effective communication (Lauer 2021). So, it is the responsibility of the organisation leadership to communicate the changes down the value chain of the organisation so that all stakeholders clearly understand it. Besides fostering honesty and providing a sense of direction, communication helps to overcome resistance and defuse potential

disagreement. Tang (2019) asserts that to convince stakeholders of the need for change, management must communicate the rationale behind the change. The TOE theory suggests that the adoption of new technology in an organisation is influenced by technological, organisational, and environmental factors (Tornatzky and Fleischer 1990). Organisational factors include aspects such as the readiness of the firm for change and the management strategies in place to facilitate this change. Effective change management can help to overcome resistance to change, improve the skills of employees, and ensure the successful integration of new technologies like Industry 4.0. In the context of South Africa, this factor might be particularly important. The transition to Industry 4.0 represents a significant change for many South African accounting firms, requiring new skills, new processes, and potentially a new organisational culture.

b) Awareness

More communication can create awareness for staff so that they are aware of the impending implementation and the benefits thereof. Creating awareness can promote more uptake and expedite change in a positive manner.

Participant **#4** explains that firm leadership needs create awareness about Industry 4.0.

"We have a lot of awareness about company's vision… so every training includes section and data analytics and the tools available what can be done in the relevant audit sections in every meeting that we have we bring it up with the staff as well to create awareness we have posters everywhere".

Participant **#12** suggests that management needs to raise awareness about Industry 4.0 to avoid any resistance from staff.

"and to educate the staff so that they can follow through because if there's no motivation, staff may revert to old ways of doing things… so management must communicate, educate and motivate various stakeholders on the importance of adopting a particular technology".

Raising awareness is novel approach of dealing with or overcoming resistance. It is essential that the change management strategy incorporate both awareness and preparation for transformation. Only when all stakeholders understand the

significance of adopting Industry 4.0 in full that it will have the anticipated outcome. Thus, it is the manager's responsibility to understand how modern technologies can improve business processes and make sure everyone is aware of the importance of digital transformation (Kreutzer, Neugebauer and Pattloch 2018). In addition, Bish, Newton and Johnston (2016) assert that any change initiative needs to be communicated to workers so that they are aware of it and understand how it will affect them. Consequently, absence of awareness may have a negative effect on Industry 4.0 adoption and on employees in terms of adjusting for change.

c) Buy-in

Communication can also promote staff buy- in into the idea of Industry 4.0 and they can embrace the change thereof.

Participant **#7** points out that accountants are likely to support the implementation of Industry 4.0 if they understand its benefits.

"Make them understand that it's just part of us trying to be more efficient as the company and it's not about you as an individual… it's just a direction and you need to buy into that idea that this is the direction we are moving and we want everyone to be efficient, effective and we want to reduce a lot of holes in the system where the time goes unbillable… so it has to filter down from top to bottom".

Participant **#8** believes that it is important for management to get support from the employees for the implementation of Industry 4.0.

"It is also essential for management to get the buy-in from employees and this can be achieved through convincing employees on the significance of change and how it will improve their work. Once employees are willing and ready to embrace change, it become easy for Industry 4.0 to be implemented…and management does play a leading role in communicating change".

The creation of a convincing argument outlining the reasons why the current business processes are unsustainable is essential to getting employees and other stakeholder's buy-in. Managers cannot bring about substantial change without their followers being inspired to do so (Hussain *et al*. 2018). Therefore,

management should communicate effectively throughout the implementation of Industry 4.0 journey to gain the support of all stakeholders. Also, it is the responsibility of management to foster an environment where employees are prepared for and motivated about Industry 4.0 adoption. Mangundjaya and Farahzehan (2019) assert that emphasis should be placed on securing management support and other influential parties who could help the change initiative move successfully.

d) Informed and transparency

Communication can keep staff informed of the developments and in turn promote transparency. In this way, staff and stakeholders will not feel as if Industry 4.0 technologies are being imposed on them.

Participant **#8** points out that employees and other stakeholders must always be informed on any changes during the implementation of Industry 4.0

"Communication is an essential component of leadership during the change process, people need to be regularly informed about the new developments happening in the company during change".

Participant **#1** believes that firm leadership must be open to the employees and other parties that will be affected by the adoption of Industry 4.0.

"Management must also be honesty with employees about how change is going to affect them… whether positively or negatively and what the organisation will do to manage the impact of change".

It is crucial for managers to effectively communicate the intended changes to all stakeholders as it may offer them the information, they need to make informed decisions about the change initiative. Mangundjaya and Farahzehan (2019) explain that a change leader's responsibilities include not just implementing and overseeing the change itself, but also communicating and socialising it throughout the organisation. So, managers must share with employees the information on implementation, the progress, the outcomes of the Industry 4.0 adoption. It is necessary to demonstrate to the employees that the advantages of adopting Industry 4.0 would be beneficial in the long term than interruptions that are inevitable in the implementation to gain their buy-in (Wang *et al*. 2017).

So, it is extremely important for firm leadership to be honest and communicate proper message at the appropriate moment at all stages of implementation of Industry 4.0.

6.2.1.2 Mindset change

It is also up to leadership and management to promote a mindset change to staff and stakeholders. Mindset change can only be possible through ongoing empowerment, awareness and communication of staff and stakeholders. Hence it is up to management to first understand the systems thoroughly before attempting mindset change for stakeholders and staff.

Participant **#2** points out that it is the role of firm leadership to promote culture of change in the organisation.

"Is to motivate the employees by giving staff that peace of mind that change is not going to overwhelm them because many will feel overwhelmed… but also communicating to them how the change is going to happen, planning, and creating a working environment that allows for them to at least see if they are competent with the automated online system to see where the weaknesses is and where is their strengths".

Participant **#3** indicates that it is the duty of management to allay any fear from the employees which will subsequently make them change their minds towards Industry 4.0.

"Like I said before change is not something that is easily taken by most people because there is a perception but sometimes it's true that this change is going to bring some negative issues or impact to some other employee…so some may try by all means to resist it. So, as management we need to educate our staff members and other stakeholders the benefits of this new system we are going to implement or of change and also to assure them that they will not be thrown under the bus after the change otherwise you will not get their positive contribution for the new system".

Senior management fosters a sense of confidence on their team members by encouraging them to adopt Industry 4.0. A leader encourages those under him to develop themselves intellectually and professionally so that they may

contribute significantly to the success of the organisation. Therefore, organisational change necessitates a comprehensive cultural shift as well as a shift in employee thinking (Yeshitila *et al*. 2020). This eliminates the formation of a "them and us" mentality, which leads to an inevitable backlash against the proposed change (Franklin 2021). Thus, the firm's leadership can encourage employees' and other stakeholders to change their attitude towards Industry 4.0.

6.2.1.3 Planning

Management also has the responsibility of planning for the change. This means that all necessary budget, resources and trainings and developments must be done and allocated.

Participant **#13** expressed the view that firm leadership need to carefully plan for the adoption of Industry 4.0.

"Planning is important when you are introducing new system. For example, if you don't have enough skills, it is better to outsource these skills so that you give your staff time to be trained for the new change…let's say you are moving from old system to the new system the company itself may not have the enough exposure to the system. So, it is better to get maybe the service providers to do inhouse courses or training so that the transition is smooth".

Participant **#8** suggests that it is the responsibility of firm leadership to plan for any change initiative which might include the allocation of resources required for the implementation of Industry 4.0.

"A lot of time will need to be spent on the planning of change to ensure that all aspects and effects of change are considered before implementation is undertaken. Planning will also include allocating the required resources to adopt Industry 4.0. The resource includes skilled employees to help adopt Industry 4.0 and funds for the project".

Participant **#9** also concurs with other participants that the role of planning rests on the senior management.

"But also, as manager of the company all the planning work rests on your shoulders and you have to make sure that this is communicated to all employees and other stakeholders".

Managing change requires effective and meticulous planning right from the start, and this responsibility rest on the firm's leadership. Tang (2019) indicates that it is the role of senior management to plan for the organisational change. The adoption of Industry 4.0 requires adequate planning, effective communication, and collaboration with all stakeholders. During the planning, firms' leadership will be able to determine the number of resources (human and financial) required for the successful implementation of Industry 4.0. The firm's leadership is in charge of analysing and planning the firm's vision and strategy as well as explaining how the planned changes will help the organisation reach its strategic goals (Franklin 2021). This minimises the emerges of defiant attitude which always leads to backlash against the implementation of Industry 4.0. Therefore, ineffective planning occurs when different groups fail to communicate with one another. Moreover, planning ahead is necessary for the effective use of information in transformation processes (Lauer 2021).

6.2.1.4 Culture and environment

It is up to management to create a strong culture and enabling environment towards embracing Industry 4.0. The findings align with both the TOE and the Institution theories. In the TOE, organisation factors such as the culture of the firm and the role of management in shaping this culture can influence the adoption of Industry 4.0. A culture that is open to change and innovation, fostered by supportive management, can facilitate the adoption of new technologies like Industry 4.0. The Institution theory suggests that organisational decisions are influenced by institutional pressures, which can be regulatory, normative, or cognitive (DiMaggio and Powell 1983). Cognitive pressures include shared beliefs and common understandings within an organisation, which are part of its culture. If the culture of an accounting firm aligns with the adoption of Industry 4.0, this can act as a cognitive pressure supporting adoption.

6.2.1.4.1 Motivate

Employees will be scared of change due to implication on their jobs, duties and overall work environment. Hence, it is up to management to motivate employees and make motivation part of the culture. This will prevent employees from

becoming despondent and anxious. Staff will also feel motivated to embrace the new system when they are aware of how they will fit in to the new system.

Participant **#5** suggests that leadership must motivate employees to see the benefit of adopting Industry 4.0.

"But also, management needs to motivate employees to embrace and understand the change and then implement the change. What I have noticed is that competent employees that understand the benefits that may come from adopting particular technology are more willing to implement it because they understand if they can get it, they can do so much… so there is no need for management to motivate them or get their buy-in".

Participant **#6** posits that employees need to be motivated to embrace Industry 4.0.

"When new systems are introduced it's the responsibility of management to motivate employees to accept these changes brought by the new technology being introduced because when individuals are not happy with the technology being introduced, they may end up sabotaging the system because they want to remain doing thing in same way they have been doing".

Participant **#7** explains that its important to keep employees motivated during the adoption of Industry 4.0

"So, my role has been to keep a positive employee morale and to creates and communicate a vision of the company by showing the direction where we are headed".

Participant **#8** believes that employees will work hard to achieve the organisation goal if they are motivated by senior management.

"For employees to effectively implement Industry 4.0, they need to be motivated by the management. Part of the motivation is through creating a compelling vision for Industry 4.0... a well-crafted vision can inspire the staff to work towards achieving it".

Participant **#9** points out that employees are motivated to implement changes that they have participated and therefore it is the responsibility of management to involve employees in the implementation of Industry 4.0.

"But also, when planning for any change or adopting new technology it's better to get some employees involved this way, they will not feel excluded, but they will feel valued and motivated to adopt any changes as they feel they belong and have been part of the project. Remember it's the management that is charged with drafting the company's vision and strategy, so you are like a pilot of the company. So as a leader you need to motivate employees and create plan for change and improvements as well that's why we keep telling our employees that you are not just here for the sake of getting a salary you have to improve yourself you have to learn something new".

Management plays a role in motivating employees and other stakeholder to embrace Industry 4.0. Wu and Parker (2017) reveal that change can only happen if individuals who must adapt to a new way of doing things are convinced of the necessity for transformation. Individuals may be motivated to adopt Industry 4.0 when they are offered the chance to take part in establishing the new strategy. Leaders can encourage followers to take initiative by enhancing their sense of competence and motivation. Additionally, people are more likely to embrace the Industry 4.0 when they feel like they had a hand in planning. Individuals that are motivated have a greater tendency to participate in the task voluntarily, exhibit high degrees of innovativeness, and eager to improve their abilities as they work.

6.2.1.5 Create enabling environment

The management must create an enabling environment by providing tools, resources and training for staff and also allowing them to bring about creative ideas.

Participant **#6** suggests favourable environment for the implementation of Industry 4.0.

"Management must create a conducive atmosphere or environment for change otherwise it may create resistance among different stakeholders".

Participant **#8** explains that it is the role of management to create an environment that allows employees to exercise their creativity.

"Management has a fundamental task of creating a conducive environment for change, this includes creating the culture for creativity and allowing employees to experiment their ideas".

Participant **#9** points out that management can create an environment which will make employees happy.

"We also have to create a good working environment because when your employees are happy, they will be motivated to give extra effort to the company".

Participant **#11** also concurs with other participants on the need for management to create a good working environment.

"Create a general satisfactory and conducive work environment".

Implementation of Industry 4.0 in an organisation brings a lot of changes and is likely to cause discomfort among employees. It is the role of a leader to pay attention to his employees' concerns and address them in a suitable and positive manner (Yousaf *et al*. 2019). This creates conducive working environment and minimises the possibility of resistance against implementation of Industry 4.0. Organisation leadership establishes positive relationships with a variety of employees by clearly articulating the organisation objective and explaining what the expectations are and why (Kim and Koo 2017). Thus, conducive working environment can encourage smooth implementation of Industry 4.0 through creative and flexible thinking by the employees.

6.2.1.6 Leadership drive

Leadership must be driven to change.

6.2.1.6.1 Vision, goals, and objectives

Leadership and management must create the vision and formulate goals accordingly. A strategy must hence be developed to meet those goals.

Participant **#11** suggests that it is the role of craft digital transformation strategy that will be implemented by the organisation.

“As a leader my work is to craft information technology strategy that needs to be followed because I have to ensure that strategies aligned with corporate strategy. So, it’s my duty as a leader is to guide and to select the appropriate technologies that we need to implement in our organisation and how it’s to be implemented”.

Participant **#12** explains that leaders drive organisation strategies and guides employees on the objective of the firm.

“The major role that we play as leadership is motivating the employees and educating them on the importance of this technology that we are bring into the organisation why we are implementing it, why we need it and the benefit that is going to accrue to the company so there is that need to reshape the vision to recreate the mission objectives”.

Firm's goal and vision can only be realised with good leadership. In addition, firms’ vision and objectives are shaped by firms’ leadership. A leader must routinely solicit input from his team which helps him guide the firm’s growth in manner that is in line with organisational objectives. Therefore, leaders gain support by communicating a compelling vision and driving goal to their followers (Jabbar and Hussein 2017). Firms’ leaders set the long-term direction of the company, formulating its overall strategy, and overseeing its operations. Leaders can win support of their subordinates by attending to their interests and guiding them. Thus, leaders discover talent both within and outside the company and plans for the next leader through mentoring and careful hiring (Albukhitan 2020). Consequently, it is essential for leadership to focus on fostering connections among team members and assisting them in understanding and pursuing a shared goal.

6.2.1.7 Role modelling

Managers need to act as role models and ‘walk the talk’. If managers act a role model in embracing technology, then employees will feel more inclined to follow. Managers must lead from the front and deal with challenges accordingly.

Participant **#1** believes that for employees to be motivated about Industry 4.0 adoption, the leadership must be seen as leading the change initiative.

“Management play very critical role right in influencing the way employees do their work, so for instance if you have a manager who's lax the employees tend to just follow suit, they'll become lax but if a manager is strict and he's goal driven employees would also tend to be strict, and goal driven at the same time”.

Participant **#2** suggests that employees will be motivated when they take leading role in the adoption of Industry 4.0.

“Of course, management has to lead by example because it has to come from top management and flow down… this way employees will be motivated when they see that management is at the forefront. I'm someone who knows that as much as I'm an account, IT is very important in this industry and myself, I sometime struggle with simple IT tasks so I would understand if no one in the firm actually knows what they doing that obviously affects as a domino effect”.

Participant **#8** elaborated that when managers lead by example, employees will also follow as they will have confidence on the success of the change initiative.

“Managers must lead from the front and be role model to employees by leading by example. They must demonstrate behaviour required for change and commitment to the change project. Managers also need to use different leadership styles that are effective in influencing staff to embrace change… leadership is about influence, therefore managers should find ways to manage staff during a complex situation such as change management”.

Participant **#12** believed that employees will be inspired to follow when leaders’ pledges support for Industry 4.0 adoption.

“You need to be on the forefront to show people that it's possible and to show the people how much you support this technology… that way you are also trying to get the employees buy-in by explaining and selling this technology to them indicating the benefits that they are going gain”.

Firm leadership should be at the forefront and be seen as the champions of Industry 4.0 implementation. Franklin (2021) explains that being in the lead inspires subordinates to get involved because it makes them feel like they can as well accomplish that goal. This will motivate employees to embrace Industry 4.0. Moreover, respect and emotional connection are necessary for role

modelling to be effective in encouraging employees to cooperate in the organisation transformation (Markey *et al*. 2021). A leader motivates and inspires his team by serving as an example and assigns them responsibilities that will improve their performance (Markey *et al*. 2021). This enables the leaders to understand the abilities and weak points of their members. When employee's look up to a leader, they get inspired by the values they uphold. In addition, the firm's leadership has the ability to motivate their employees to adopt Industry 4.0 by being role models of the change they would want to implement.

6.2.1.8 Operational

Manager also must deal with operational matters as so the system become operations.

6.2.1.8.1 Operationalising goals

Goals must be operationalised in terms of allocating adequate resources are allocated towards the system implementation.

Participant **#1** shared the following views regarding managers role in operational matters.

"Strategic goals of the organisation are broken down into the level that the employees understand so the role and the influence of management is very critical".

Participant **#11** points out that it is the responsibility of management to appropriately allocate resources relevant for the adoption of Industry 4.0.

"And they allocate enough human resources and the decision whether to actually to purchase the technology locally or outsourced the technology".

The onus rests on the firm leadership to allocate human and financial resources required for the smooth implementation of Industry 4.0. Carnall (2018) indicates that the firm leadership decides how resources should be distributed to enable the organisation to achieve its goals. The implementation of Industry 4.0 is incomplete without allocation of sufficient resources. Effective managers create and reorganise the organisational structure by giving tasks and resources to various departments (Rosenbaum, More and Steane 2018). Additionally,

effective management demands the ability to coordinate the allocation of resources, personnel and technology to achieve set goals (Jabri and Jabri 2022).

6.2.1.8.2 Staff training

Management must ensure that adequate skills development is provided through training as, so they are ready to utilise and operate the new systems.

Participant **#1** suggests that the role of identifying employees that need to be trained in preparation for the adoption of Industry 4.0 rests on the management.

"Staff training has to be in place when new systems are put into place whereby employees are trained on how the new system operates… so without training nothing will change because training brings about an understanding of the system, that people are equipped and know exactly what they are supposed to do… this can be done inhouse by the service provider or staff can be sent for course".

Participant **#4** points out that it is the responsibility of firm leadership to put in place training programmes that are aligned with the vision of the organisation.

"…the first one is implementing organisation goals like the CA 2025 program SAICA which we are involved in… that process requires us to set up a training mechanism to ensure that this year's first year article clerks get trained on data analytics by the time it is 2025".

Participant **#7** also explained that it is the role of management to develop training programmes to meet the strategic goals of the firm.

"I was also responsible for staff planning in terms of what training the SAICA trainees need to do, what type of training are they required, how many trainings are they supposed to do in a year… and you have to also discuss reviews they have to do, skills analysis and skills reviews happen every two months, skills analysis every six months and also check the progress and what other skills they need… and where we can place them on projects in terms of what else they need to do… so that has been my role".

It is important to realise that employees will require some time to learn and adjust to the new system when it is been introduced. Firm will need to decide for time

their workforce will require to complete training and hone their newly acquired skills as the organisation moves closer to the actual implementation of the new system (Carnall 2018). Therefore, staff training is imperative for the implementation of Industry 4.0 and any other new technology that the organisation intends to adopt. Implementing organisational change requires training, learning, and the acquisition of new capabilities (Bögel *et al*. 2019). Consequently, it is the responsibility of the senior management to make sure that the staff receive adequate training to better prepare them for implementing change.

6.2.2 Sub-theme 2: Responding and recovery to cyber security breaches.

It was important to also ensure a strong response to cyber security breaches.

6.2.2.1 Security

Security was ranked the highest in terms of response. It entailed a plethora of measures.

6.2.2.1.1 Antivirus

Antivirus and firewalls were the most highly ranked security measures. Antivirus prevented virus infections and could detect malicious emails and software. Anti-malware can serve to remove malicious software such as trojans a spyware that could spy on the firm network.

Participant **#1** explains that having antivirus installed in the system can warn employees of malicious activity in the system.

“Having an anti-virus software is very important but now days computers come with ani-virus installed but we also have additional antivirus installed in our system”.

Participant **#2** believes that firewall and antivirus can avert any risk posed by malware.

“We do have firewalls and we utilise the Norton antivirus on our main server, so this is our first line of defence and prevents any intrusion, but also warns us of any suspicious email”.

Participant **#13** also emphasises the use of antivirus as means of protecting computer systems from cyber criminals.

"Antivirus software must always be installed and updated because antivirus helps to detect malicious emails".

Participant **#6** elaborated that having active firewalls and antivirus installed in the system is the first line of protection

"we also ensure that our systems are regularly updated with security updates and ensure that firewalls are working well because they say the first line of defence would be firewalls that will send a signal to you through the anti-viruses that warn you of potential phishing e-mail or a virus".

Participant **#11** also concurs with other participants on the importance of having antivirus installed in the system.

"but we also use antivirus software packages to protect our systems from viruses".

Antivirus must be installed as first measure of protection to stop and identify malware in the system. Therefore, anti-virus software needs to be installed and updated periodically (Manjezi and Botha 2019). Antivirus software's stop or warm system users about malicious intrusion in the system. For example, an antivirus software warms users not to click emails coming from suspicious sender. Cybercriminals will use any means at their disposal to identify and target computer system that are not protected by antivirus software and other layers of protection (Talesh 2018). Moreover, software designed to detect malware can identify it depending on its signature or behaviour (Green 2017). Software updates are essential because they provide improved capabilities that will protect the system from ever growing malware threats (Allen 2017). Therefore, antivirus software must be installed and always updated as it offers first line of system protection.

6.2.2.1.2 Firewalls

Firewalls serve to monitor network traffic and detect malicious files and hackers. They must be regularly updated.

Participant **#8** explains that firewalls are essential in protecting organisations from cybercriminals.

"There are a number of things a company can do to prevent hacking this include installing a firewall. Hackers operates on the internet, and they can send calls to thousands of computers and wait for a response. The firewall prevents the computer from responding to the hacker's call. Firewalls needs to be updated regularly and be properly configured".

Participant **#9** also agrees that firewall must active and always up to date for adequate protection when on internet.

"but also, our system has firewalls active, and the system always downloads and installs updates at night".

Participant **#11** suggests that using firewall offers protection against organisation network connected to the internet.

"we must have firewalls and our staff have the knowledge of keeping and maintaining these firewalls we also keep our systems always updated".

A firewall software prevents unauthorised access to a computer network when they connected to the internet. A firewall is a crucial security feature that must be installed in all Industry 4.0 systems. Thus, firewalls need to be active and always up to date when the computer systems are connected to the internet. Khoumsi, Erradi and Krombi (2018) explain that firewalls are essential components of network security and are frequently utilised as the first line of defence against various attacks. The use of a firewall is now universally acknowledged as an essential component of any comprehensive network security strategy (Togay *et al*. 2021).

6.2.2.1.3 Credentials

Credentialing in terms of ensuring all authorised users have passwords and usernames. This can allow for tracking and tracing who had logged on to the system. However, user should not share their passwords.

Participant **#1** believes that using a username and password ensures that the correct person is the one logged in.

“the use of passwords and login usernames are very critical and for every employee it should be a mandate that each employee's PC is password protected, username protected and those passwords should be changed more often because of hacking… and there should be a log reports for instance where information is changed from the main database”.

Participant **#2** explains that using passwords and login authentication the firm can control access to its network.

“We utilise login authentication and passwords especially for our clients we have a database called “act” it has a list of all our clients and their personal information so for one to access this it requires logging authentication through password and one time pin (OTP)”.

Participant **#4** points out that to avoid unauthorised access to the organisation network, firms now require users to have login details for them to have access to the network.

“So, most companies now that have a username, password to access the network… you can only access using the company laptop, but you can't access with your own laptop”.

Participant **#6** indicates that users must create strong password and should continuously change them so that they cannot be easily guessed by cybercriminals.

“we also encourage the use of stronger passwords and continually changing our employees’ passwords that way it helps us to ensure that whoever accesses the system is first authenticated through our system”.

Participant **#8** also encourages the users to create complex passwords and use firewalls.

“Strong passwords and strong firewalls”.

Participant **#9** highlights the need for users not to share password to avoid unauthorised person from accessing the firm system.

“Passwords are very critical you cannot share that with anyone”.

Access to any systems must be protected with strong password and username. In the absence of complex and strong passwords, data cannot be properly secured, and the information can be accessed without difficulty. When a malware attack happens, the first line of protection is often a secondary storage system, but if that system's password is not strong, malware can simply get access to it and cause even more damage (Yaacoub *et al.* 2021). Passwords should be made to resemble keys, which have intricated dents which make them tough to duplicate. Yaacoub *et al*. (2021) submit that secure password is a crucial part of any well-established cyber-security system. Passwords are how one gains entry to protected systems.

6.2.2.2 Authentication and restriction levels

Relating to the above, Authentication and restriction levels should be placed on used. This means that users should be restricted to certain aspects of the system only. For example, stock controller should only have access to inventory and order subsystem. They would not need access to the financial components.

Participant **#1** explains that user authentication helps the organisation to users and restrict access to some information which is not relevant to them.

“There's so many things that organisations can do to make sure that access to information is only restricted to authorised personnel, computers can be tied or locked up and have employees who only have access to information that they need only like for instance a warehouse clerk does not need information about salaries… so when they log into the system, they are restricted to stores information records of what is coming and what is gone out versus what is been issued in terms of the stock”.

Participant **#2** suggest that having internal control helps to safeguard access to the organisation network and information.

“Additionally, we have internal controls in place where certain staff only have access to certain aspects of the business and information for example front desk administrator does not need access to client’s bank statement”.

Participant **#3** elaborates that having different techniques for identifying system users helps prevent unauthorised access to the firm network.

"multiple layered authorisations for example one guy came here and was trying to install certain operating system on the computer that belonged to the organisation but within few minutes he received a call questioning him what's trying to do… that call came from the IT administrator so the IT administrator should have the rights for each and every user to prevent unauthorised software installations".

Participant **#7** also emphasis the use of passwords and user authentication for users to access the organisation system.

"but also when you get into the system you need passwords and authentication for example now in my phone if I log into my computer it will send a message to this app whereby I would need to confirm that it's the correct person who is login in… so I have to go download this link with my user password into my phone and then I have also to login to the system and also confirm so two factor authentication… so things like that to increase security".

Participant **#10** encourages firms to create multiple layers of authenticating system users.

"We have set-up additional layers of authentication where there will be two factor authenticators being used but there is that risk where anyone can have access to your information".

Participant **#12** explains that login authentication restricts junior employees from accessing sensitive company information not relevant to their daily work.

"Login authentication also prevents every employee to have access to the system as much as they are our employees but it's better be kept to minimum number of people that are known and then the login are given to them or we can separate the system… create username for each and every person rather than creating a one universal login and everybody is login using that same name… so whenever something happened nobody is going to come forward… so it's better everyone is given their username and login details".

User authentication techniques should be prioritised to safeguard Industry 4.0 networks from unauthorised access and cybercriminals. Mohsin *et al*. (2017) reveal that authentication continues to be a crucial defence against unauthorised

access to network systems and any information. The current best practice for preventing unauthorised access to user information is multifactor authentication (Dasgupta, Roy and Nag 2017). The multi-factor authentication system uses biometrics for automatic detection of people according to their behavioural and biological traits (Ometov *et al*. 2018). Thus, authentication of users is a crucial element for keeping Industry 4.0 networks and information secure. Controlling who has access to computer data can stop any misuse of data.

6.2.2.3 Encryption

Encryption of files would serve to ensure that only the intended recipient of the file would have access to it and nobody else.

Participant **#8** suggests that encrypting files, active firewalls and user authentication can avert cyber-attack.

"However, most of these cyber-attacks can be prevented by using encrypted file, strong passwords and strong firewalls".

Participant **#11** indicates that they encrypt the organisation file to prevent an unauthorised person from extracting encrypted information from the files.

"And the other thing is we do encryption of our data so that it is not easily readable by everyone and also, we protect our documents with passwords like when I sign a pdf file, I put a password to protect it".

Participant **#12** elaborates that they encrypt their data to ensure privacy and security of the information.

"But also ensure that we encrypt our data as it moves from our emailing to third parties which ensures that there is security and privacy and documents that are sent are password protected and the password is communicated to the receiver of document".

Encryption helps ensure that company's or personal data remains secure even if it is compromised. Brody (2017) explains that there is a need for users to encrypt data in order to conceal it. Adel, Sarwar and Hosseinian-Far (2021) posit that firms can decrease the threats of data breaches by adopting essential security measures like encryption. Data theft can be prevented using irreversible

encryption and a high degree of isolation (Adel, Sarwar and Hosseinian-Far 2021). Thus, when encrypting sensitive information, it is essential to employ random numbers with unpredictable pattern. Data encryption adds extra layer of security to protect sensitive personal and firm information.

6.2.2.4 Proactive

Proactive ensure can also be looked at such as the following.

6.2.2.4.1 Staff awareness and training

By ensuring continuous staff awareness and training on security breaches and online risks, staff can become aware of what potential hackers can do to obtain information from them. They can also be aware of what suspicious emails and files may look like. This can make them avoid such emails and other related malicious software and files.

Participant **#2** believes that data breaches can be prevented by changing human behaviour through cybersecurity training.

"Staff training makes sure that staff know the A-Z of how to process, how to backup, where to keep things, where to store things especially on the server but this also improves staff awareness on how some of these data breaches happen because antiviruses can play their part but we as humans also need to play our part".

Participant **#3** suggests that data breaches can be avoided when staff are continuously trained on cybersecurity issues.

"staff training should be in ongoing thing in any organisation and should not be an event that is once off, staff should be trained on how to prevent, how to react to cyber-attacks say for example emails from unknown sources they should be totally maybe blocked… but maybe only business emails for PC's at any organisation or they must have software that should alert them to a suspicious e-mail or check with your IT administrator something like that".

Participant **#5** believes that influencing human behaviour through cybersecurity awareness can decrease the incidences of data breaches.

“You might think that it's going to be technical how you respond but it's actually not that technical the most important thing is making sure that people are aware of the cyber-attacks, how they happen and what are the types and also how they come about… so if you can get people to be aware then you would have done most the work you need to prevent these attacks. Damage can be done by someone opening an email if they are not aware. But also, some employees may not login and logout and making that the connection is secure, but the most important thing is awareness”.

Participant **#6** also believes that constant reminders about cybersecurity may eliminate data breaches in the organisation.

“We also conduct regular awareness during our meetings where we remind employees the importance of being vigilant and not clicking on suspicious emails and our new employees are always taken into training program to teach them about the issues of systems how they should behave when dealing with systems, so they are taught and always made aware of the risks associated with hacking, viruses, and phishing”.

Participant **#7** elaborates that training staff on data security improves their awareness of cybersecurity.

“I said earlier on I attended 2 weeks training just on cyber security so in terms of training staff it has made me aware of certain things that I was just doing carelessly that now I need to pay more attention to… like someone who sends you an e-mail with a link but the person looks like they're from inside the organisation but when you check the link the it does not correspond with it doesn't have anything that has to do with organisation or what they're trying to say like those ones you see like yk.com… you know funny links like that and when you press on that link you think it's safe and by the time you realize it they've already installed the bug by you just clicking on the link… so simple things like that that you don't pay attention to or say claim your prize and click on it and then you realise that your system is compromised or they have access your bank information and then money coming out… so simple things like that hackers are always trying to find ways so constant training and development of staff is very important”.

Participant **#12** explains that training staff on cybersecurity improves their awareness on cybersecurity.

"Staff also needs to be trained in terms of access to the system, safe portals, where they can access the system from and not to use public systems, so training is very important as it increases staff awareness about cybersecurity".

The likelihood of a data breach stemming from phishing emails may be decreased with an organised and thorough training programme. A programme for educating employees on cybersecurity awareness should include instruction on recognising and responding phishing emails (Sheffield 2017). Training and awareness campaigns can instil cybersecurity culture in the minds of employees that will benefit the firm in future. Miranda (2018) asserts that raising awareness about data security is a preventative measure that will equip employees with the understanding to identify malware and prevent them. When staff are trained and aware of cybersecurity incidences, they can analyse and rectify security flaws. This indicates that technical approaches alone cannot adequately reduce security breaches (Furnell and Clarke 2012). The actions of individuals have a significant bearing on the cyber security of an organisation that is why it is important for firm leadership to promote continuous data security training and awareness campaigns within the organisation.

6.2.2.5 Cyber insurance

A new and emerging form of insurance is called cyber insurance as the world moves more towards online modalities. Cyber insurance can protect companies legally and serve to recover losses through cyber breaches. However, this can come at as added cost.

Participant **#2** explains that cyber insurance covers the costs in case of a cyber-attack.

"Cyber insurance… actually I'm not familiar I don't think we have anything with regards to cyber insurance. I would assume that's something that we would definitely need to look into I've actually never heard of cyber insurance… so I guess with everything going online that's something to look into because I mean insurance can ensure basically anything these days. So, cyber insurances I

would assume is looking at the future to make sure that of course you are protected in the event that anything happens like litigation costs… so yeah you don't want to be in a position where you are being sort of having legal action against because something that's beyond your control".

Participant **#3** suggests that cyber insurance is essential in the contemporary business environment as it decreases financial burden arising from cyber-attack.

"Cyber insurance should be a non-negotiable matter whatever you think can be at risk and you are likely to suffer a loss you better insure it… like what happened recently with floods in some places nobody thought these areas can be affected by floods, but it happened, and it was the first time".

Participant **#13** highlight that cyber insurance cushions financial impact emanating from cyber-attack.

"The issues of cyber insurance I would say for a small business maybe when they look at the cost and say maybe it's not warranted for us to have it… but for a huge business let's say for parastatal like Eskom or SARS they are dealing with a lot of sensitive personal and company information so it would only make sense that they get insured for data breach… so it's essential for big business and medium but small and micro businesses it might depend on the cost and their resources".

Participant **#8** recommends firms to invest in cyber insurance to lessen the financial

"It is important to secure your wireless network to avoid cyber-attacks. In addition, when using a public Wi-Fi, it is essential to avoid sending sensitive personal information. Moreover, firms need to invest in cyber security insurance".

It has become necessary for businesses to invest in cyber security insurance in response to the financial penalties and other loses associated with data breaches. Businesses can protect themselves from financial collapse in the event of a data leak by purchasing cybersecurity insurance. Xie, Lee and Eling (2020) suggest that the need for cyber insurance policies have been driven by firms that have been affected by data breach. Insurance coverage is offered for damages directly related to revenue loss from clients (Petratos, Sandberg and

Zhou 2018). However, it might be impossible to assess the reimbursement value and how it relates to the intellectual asset. Though, some insurance companies have created separate cyber insurance policies to satisfy the needs of some customers with complex cybersecurity risk exposures (Santos 2017). Therefore, firm leadership need to consider cyber insurance to safeguard the assets (intangible and tangible) and future of their companies from the catastrophic implications of cyber-attack. Having cyber insurance encourages clients to implement strong security measures to avoid the rejection of the claim by insurer.

6.2.2.6 Regulatory

Regulatory requirements must be followed adroitly.

6.2.2.6.1 Policies

Internal policies must be developed in accordance to systems governance. Such policies will guide users and stakeholders on the utilisation of such technological systems in line with the accounting regulations. Internal policies must be aligned to national policies and acts as well.

Participant **#10** believes that putting data security policies in places guides employees on data handling and procedures to follow in case of data breach.

"I think organisations must have a policy in place on how to approach that and how you communicate because the risk is there as much as you can put in place internal controls to mitigate that risk but, the risk won't be 100 percent eliminated…but it's something that hasn't happened to us yet but, we try as much as possible to protect the information and should it happen you know we have policies in place to ensure how to go about to it".

Participant **#12** suggests that its important to have data security policies in place to deal with how clients' data is handled.

"The risk is inherent in the space we are working in now so, we have put in place policies on data security and how client's data must be handled".

Firms' data security policies must prioritise security measures like password protection, data backup, and user authentication. Additionally, data security policies must be drafted with malware detection and mitigation best practises in

mind to safeguard businesses from this growing threat. These regulations ought to shield businesses from online crimes like malware attacks. Gupta (2020) emphasise that the purpose of the cyber-security policy is to protect the privacy, accessibility, and reliability of the data stored online. Data protection entails the use of diverse security policies, technologies, and Information technology services to identify and defend against threats (Galinec, Možnik and Guberina 2017). However, businesses risk becoming victims of cybercrime if they do not take the necessary precautions and establish effective security policies.

6.2.2.7 Systems

From a Systems perspective, the following should be done as a proactive measure against breach.

6.2.2.7.1 Backup and restoration

Regular backups must be done. This can now be possible thanks to cloud technology and real-time backup are possible. Such backups can lead to instant restoration whenever a firm is attacked. Hence the firm does not have to remain at a standstill and can continue operations seamlessly.

Participant **#1** explains that having backup helps the firm to restore its data in the event of cyber-attack or natural disaster.

"Most organisations actually have service providers that assist them with their backups… if in the event that they lose their information or there is hacking they still have those backups that they can use to restore the system… and also some organisations have their own internal backup so it's like multi-layered backup and these backups take place like on a regular basis like on a daily basis or even on a number of times in a day such that the amount of information that is lost can be very minimal… and that's how many businesses have managed to circumvent this challenge".

Participant **#2** indicates that regular backup of data safeguards the organisation from data loss in case of data breach.

"We also do regular backups… I would say once a week we do a regular backup of all of our data processed for that week so that if there is any cyber-attack on our system, we can just restore from the backup and we will be good to go. I

know there will be disruptions for some time, but it won't be that bad like when you don't have backup".

Participant **#3** explains that having a backup enables the organisation to quickly recover from data breach.

"if you have got your backup you can start afresh quickly and you do the setup as it was before… so backup is very critical, no matter how effective your system or software is the hackers will always try to find the way in because we have even government departments being hacked… yeah there's no guarantee so the only way out here is to have proper backup".

Participant **#4** suggests that data backup decreases the chance of the firm losing data in a case of data breach.

"It's important to have regular backups at least once a month or so to ensure that if there is a breach it isn't not all is lost".

Participant **#5** also believes that it's easy to recover information from the backup system.

"The other thing is to have constant backup in the organisation so that if any data breach happens you are able to restore your system from the backup that maybe online or offline, but I would advise that businesses should always have two backups".

Participant **MA** further suggests that the backed up must not be linked to online system.

"To prevent ourselves from lose of information as result of cyber security breach we do backups twice a day and these backups one is online, and one is offline so that if files that are backed up online are affected, we can restore from the offline backup".

Participant **#7** also concurs with other participants on the need for the organisation to always have data backup.

"When you have a system running… one important thing is to have backup and it can be a physical backup where you backup information if let's say you are a company that has a lot of data that needs servers so you must have servers off

site that are running the same information at the same time so that if one side maybe catches fire or whatever reason then your information is stored in a real time somewhere… and also even if it's not that but have cloud storage where you can back up your system".

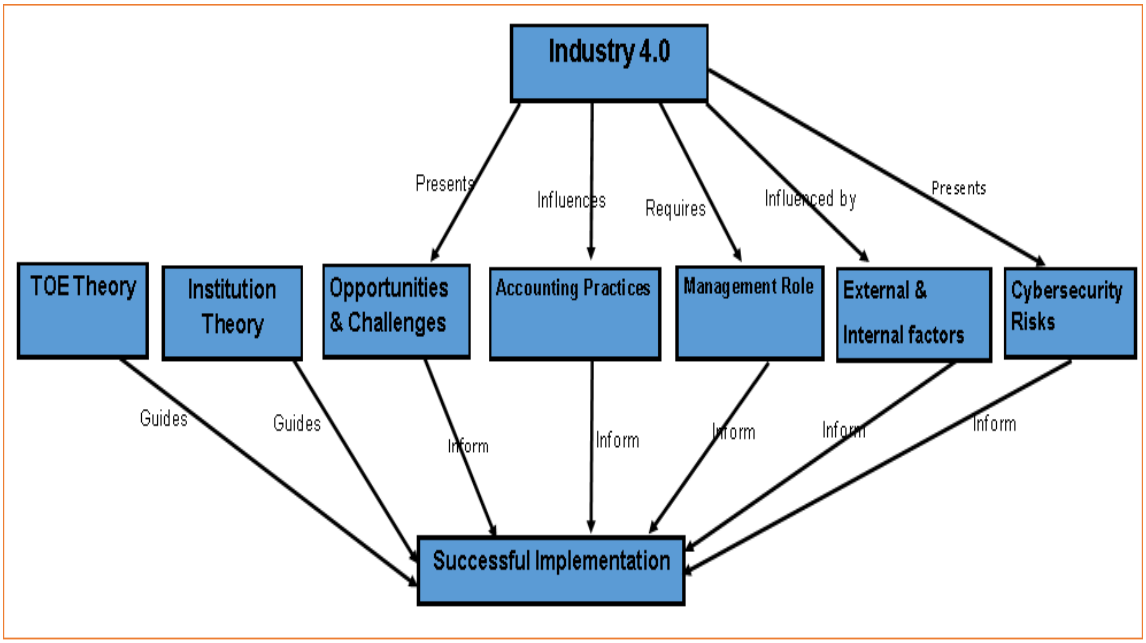
It is necessary to have backups available to maintain business operations. An organisation can restore data from backup and resume operation in case of cyber-attack or any other unfortunate incident. Moreover, backups must be stored offline because malware can corrupt files backed up online. Kanwal *et al*. (2021) opine that firms should have backup strategies in place to retrieve data in the event of a disaster. Kanwal *et al*. (2021) further suggest that businesses should frequently make timestamped copies of their backed-up data. Goldsborough (2017) indicates that the best way to reduce the impact of an cyberattack on the organisation is to frequently back up computer files. Having a backup of critical information allows businesses to resume operations sooner in the event of a cyberattack or data breach. Data backups is the best method for recovering from malware and it is also the last layer of protection for sensitive information (Thomas and Galligher 2018). The initial backup can be used to restore data in the case of a data breach or system failure.

6.3 Conclusion

The chapter presented and discussed the research findings of the study related to the role of management in implementing Industry 4.0 in accounting. The chapter further presented and discussed research findings related to the strategies employed by accounting firms to respond to cybersecurity breaches. The study found that firm management plays a crucial role in the adoption of modern technology. The study revealed that it is the responsibility of firm management to plan and create a vision that accommodates the implementation and dissemination of Industry 4.0. According to the findings, it is necessary to develop an environment that facilitates correct communication so that staff and stakeholders understand the firm's position regarding Industry 4.0. Firm management is also responsible for the allocation of resources required for the implementation of Industry 4.0.

The findings revealed the measures that accounting firms can implement to respond to and recover from data breaches. The findings show that firms can respond to data breaches by restoring data from the backup. An organisation can restore data from backup and resume operation in case of cyber-attack and any other unfortunate incident. In addition, the study showed that accounting firms can respond to data security breaches by developing appropriate data security policies. Accounting firms can also respond to cybersecurity data breaches by prioritising security measures like password and user authentication. When staff are trained and aware of cybersecurity incidences, they are able to respond to and avert cyber-attack. Encryption helps ensure that a company's and personal data remains secure even if it is compromised.

Figure 6. 3 **A conceptual framework for the successful implementation of Industry 4.0 in accounting.**



Source: Own Compilation.

In this model:

- **Opportunities and Challenges presented by Industry 4.0 in the Accounting Sector**: Industry 4.0, characterised by the integration of digital technologies like AI, IoT, and blockchain into industries, presents both opportunities and challenges for the accounting sector. Opportunities include automation of routine tasks, real-time financial reporting, and enhanced

decision-making capabilities. Challenges could be the need for new skills, high implementation costs, and potential job displacement due to automation. These factors need to be carefully considered for successful implementation.

- **Influence of Industry 4.0 on Accounting**: Industry 4.0 has a profound influence on accounting. It changes how financial data is collected, processed, and reported. For instance, with real-time data collection and processing, financial reports can be generated in real-time, providing timely insights for decision-making. However, this also means that accountants need to adapt to new technologies and possibly acquire new skills.
- **Role of Management in Implementing Industry 4.0**: The role of management is crucial in the successful implementation of Industry 4.0. Management needs to create a vision for digital transformation, allocate resources, manage change, and ensure that employees are trained and ready for the transition. They also need to manage the risks associated with digital transformation, including cybersecurity risks.
- **Factors Influencing Accountants to Implement Industry 4.0**: Several factors can influence the decision to implement Industry 4.0. These include the perceived benefits of digital transformation, the pressure from competitors, the availability of resources, and the regulatory environment. Understanding these factors can help in developing strategies for successful implementation.
- **Cybersecurity Risks associated with Industry 4.0**: With the increased use of digital technologies, cybersecurity risks become a significant concern. These risks can come from various sources, including cyber-attacks, data breaches, and system failures. It's crucial to have robust cybersecurity measures in place to protect sensitive financial data.
- **Guidance from TOE Theory and Institution Theory**: The TOE Theory suggests that technological, organisational, and environmental factors influence the adoption of new technology. The Institution Theory posits that Institutional pressure (regulatory, normative, or cognitive) influence

organisational decisions. These theories can guide the successful implementation of Industry 4.0 by providing a framework to understand the various factors that influence the adoption of new technology.

Chapter seven that deals with the conclusion and the recommendation of the study is the next chapter.

CHAPTER 7. CONCLUSION AND RECOMMENDATION

7.1 Introduction

A summary of the most important findings from the research are presented in this chapter. This chapter presents the findings of the research and recommendations, as well as a brief overview of the relevant literature and limitations of the study. The primary findings are based on the experiences of the participants regarding Industry 4.0.

7.2 Conclusion of the study

This section is broken down as per the research objectives of the study.

7.2.1 Objective 1. To examine how accounting is influenced by Industry 4.0 in KwaZulu Natal.

The study found that the emergence of Industry 4.0 has significantly influenced accounting practices. Audits teams can now leverage modern technologies for risk monitoring, identification of fictitious transactions and data analysis for anomaly disclosure. Virtual platforms such as Zoom, Teams, Twitter, WhatsApp, and other related digital platforms have influenced communication with stakeholders, enabling firms to disseminate and compile real-time financial reports. Real-time information allows for the proactive preparation of financial transactions using real-time and updated information. This means financial statements and other related documents can be based on current and factual data rather than historical data. Cloud storage and access allow for almost unlimited storage capacity but also, for instance, access to real-time information for stakeholders. Real-time information allows for proper and effective decision-making that is based on accurate and up-to-date information. Furthermore, the increase in automation due to Industry 4.0 adoption in accounting holistically brought increased efficiency, timesaving, cost-saving, real time information and storage, which inevitably led to increased output. Industry 4.0 technological advancements are transforming financial reporting.

7.2.2 Objective 2. To establish the opportunities and challenges presented by Industry 4.0 in the accounting sector in KwaZulu Natal.

In terms of opportunities, Industry 4.0 has enabled financial information to be collected and processed in real-time. The advent of real-time information supports effective and efficient decision-making and access to updated information by stakeholders. Results show that the implementation of Industry 4.0 has improved the process of preparing and compiling financial statements, increased efficiency, reduced cost, improved real-time information transfer and storage. Altogether, this led to increased output and reconfiguration of accountant's roles to focus excess labour towards other tasks. Industry 4.0 has brought improvement in data storage capacity in accounting through cloud storage that can accommodate unlimited data at minimal costs.

Cloud data storage has improved data security, and data can be accessed anytime and anywhere. Furthermore, Industry 4.0 has presented accountants with various communication channels they can use to interact with their clients for example, WhatsApp, Twitter, Zoom, MS Teams and other social media platforms. Social media platforms were found to offer accountants an opportunity to market their services to the public because they are cost-effective and offer instant feedback and engagement with clients.

Accountants revealed some challenges associated with Industry 4.0 adoption in accounting. Findings show that resistance to change, cyber-attacks, scant resources, and the lack of skilled staff were the challenges experienced by accounting firms when implementing Industry 4.0.

7.2.3 Objective 3. To investigate the role of management in implementing Industry 4.0 in accounting firms in KwaZulu Natal

Participants revealed that it is the responsibility of firm management to plan, create the vision and goals that accommodate the implementation and dissemination of Industry 4.0. According to the findings, it is necessary to develop an Industry 4.0 pro-culture and an environment that facilitate correct communication so that staff and stakeholders understand the firm's position regarding Industry 4.0.

7.2.4 Objective 4. To determine the factors influencing accountants to implement Industry 4.0 in KwaZulu Natal

The study finding indicates that accountants are influenced to adopt Industry 4.0 because of the competitive environment in which they operate. It is important not to be overtaken by competitors in service offerings, and technology currently plays a key role in service offerings. The study showed that pressure from customers and suppliers had a significant influence on Industry 4.0 implementation in accounting. Online shopping and trading offer customers and suppliers' convenience and flexibility. It was further found that technological advancement may be stimulated or inhibited by government regulation. Uncertainty in the law and regulations could slow the introduction of robotics and other data-driven services or products. Moreover, participants pointed out that pressure from accounting controlling bodies and the government influenced accounting firms to adopt Industry 4.0 for conformity.

While adopting Industry 4.0 brings about improvement in productivity, the resources of an organisation was another factor influencing accountant to adopt Industry 4.0. Financial and human resources affect the type of technology an organisation adopts. In addition, the size of the business and its processes thereof were another factor influencing Industry 4.0 adoption. The smaller the company, the more inclined they were to maintain traditional manual methods as their data volumes were not as high as larger companies. In addition, the study found that adopting new and innovative technologies has largely failed due to organisational culture. If the organisational culture was technology orientated, then technology adoption could be easier.

7.2.5 Objective 5. To examine cybersecurity risks associated with Industry 4.0 implementation in accounting.

There were various risks associated with Industry 4.0 implementation in accounting of which hacking is a major cybersecurity risk associated with Industry 4.0 adoption along with phishing, malware and virus respectively. Furthermore, there is a risk of employees leaking confidential information.

In terms of the implications of cybersecurity breaches in accounting firms, cybersecurity breaches have severe economic implications for accounting firms

leading to reputational damage with stakeholders. For example, clients whose data was compromised might institute legal action against the company. Systems failure through cybersecurity breaches can cause major operation disruptions.

Participants indicated that dealing with the aftermath of a cybersecurity breach is a very traumatic and stressful experience for management. A cybersecurity breach may lead to a decrease in productivity as management will focus on the breach and dedicate resources towards restoring the integrity of the system. Process outages or production shutdowns will cause added pressure on management which could exacerbate the stress levels on management causing them to think irrationally. Moreover, managers may be unable to handle the pressure exerted on them and end up resigning.

7.3 Recommendations of the study

The conclusions drawn from the study are discussed in this section of the chapter. The purpose of the recommendations is to offer guidance to accounting firms on how to handle the issues uncovered throughout this study.

7.3.1 Recommendation 1: Teaching analytics and systems at universities

The study showed that one of the challenges accounting firms face in implementing Industry 4.0 is the skill and competencies of accountants in advanced technologies presented by Industry 4.0. Therefore, universities and other institutions of higher learning must consider introducing data analytics and advanced accounting systems in the accounting curriculum.

7.3.2 Recommendation 2: Additional hiring and training

Different levels of competencies and skill sets are required for the successful adoption of the specified technology. Therefore, prior to the adoption of any technology, firms must consider conducting thorough skills and capability audit. When modern technologies are introduced to an organisation, there is a potential that an organisation needs to train and hire new individuals to run the system. The process of acquiring new skills and expertise must be accompanied by a

strategy for retaining that knowledge fresh in mind at least until the Industry 4.0 implementation is complete.

7.3.3 Recommendation 3: Cyber insurance

Accounting firms should consider investing in cyber insurance policies to lessen the costs associated with cybersecurity breaches. The risk of cyber-attack is inherent in the digital world therefore cyber insurance plans enable businesses to protect themselves from unfavourable outcomes without giving up on risky endeavours and their potential rewards. The goal of insurance is to transfer risks from businesses with less financial resources to those with greater financial resources. The financial cost of a successful cyber-attack can financially cripple any firm.

7.3.4 Recommendation 4: Communication

There are hardly sufficient words to describe the importance of correct communication. The researcher believes that correct communication is among the critical success elements throughout the implementation of Industry 4.0. Formal platforms must be established to communicate the entire strategy objective to implementation, showing successes, discussing shortcomings, but also encouraging open dialogue among stakeholders. This eliminates the possibility of resistance and sabotage against Industry 4.0 adoption.

7.3.5 Recommendation 5: Risks of implementing Industry 4.0.

One of the primary threats associated with the introduction of Industry 4.0 is computer hacking, that is increased in frequency in recent years. Given that accountants maintain crucial client data, a successful cyberattack or data breach at the accounting firm might substantially compromise consumer information and harm the firm's reputation. It is for this reason that some accountants and clients favour the old technology because they feel their information is more secure with the company's conventional manner of customer care rather than the more modern one. Although it is difficult to totally prevent or eliminate hacking, it is crucial and recommended for the business to periodically backup its data and have safeguards in place to secure client information. Backup prevents an

organisation from completely losing its information as a result of hacking or cyber security breach.

7.3.6 Recommendation 6: Integrating new and old systems

It is possible that incompatibility issues may arise between the various communication devices and software. It is obvious that this issue has the potential to stall the firm's digital transformation journey and may lengthen the time it takes to complete the transformation and reap the benefits presented by Industry 4.0 technologies. When implementing innovative technology, precautions must be taken to safeguard the automated system from factors that could trigger a malfunction. Therefore, it is necessary to create a formal, meticulously prepared plan of implementation that takes strategic alignment and synchronisation into account.

7.4 Limitations of the study

This study is limited to KwaZulu Natal province owing to time and budget constraints. However, the research findings are expected to reflect how Industry 4.0 is influencing accounting practices in South Africa accounting sector. The recent floods in the province which destroyed infrastructure made it difficult to conduct interviews because of the poor telephone connection.

In addition, the coronavirus pandemic was one of the main issues that led to the imposition of a national lockdown to slow the spread of the disease. As a result, most accountants worked from home, making it extremely challenging to contact them and set up an interview. Ideally, interviews would have taken place in person with participants at their places of employment; however, flooding and the COVID-19 pandemic made this impossible. Interviews conducted over the telephone also generated the amount of information needed to address the research question.

The findings from the qualitative study cannot be generalised, which is another limitation. Nevertheless, the objective of the study was to gain a thorough understanding of how Industry 4.0 is influencing accounting practices, and this was achieved through extensive interviews that produced rich data.

The study focused on one province. It was necessary to concentrate on just one province in order to thoroughly comprehend the scope of the issue through in-depth telephone interviews which generated rich data to provide a foundation for future research.

The researcher controls the delimitations which are scope limitations that confine the research (Simon and Goes 2013). The research is confined within the following variables; the influence of Industry 4.0 on accounting, challenges and opportunities of adopting Industry 4.0, the role of management in the adoption of Industry 4.0 and Cybersecurity risk associated with the adoption of Industry 4.0 in accounting.

7.5 Future research area

The study identified a number of areas that may be investigated further.

- **The ethical Implications of Implementing Industry 4.0 in Accounting.**

In the era of increased digitization and automation of accounting processes, there is a significant increase in the amount of data being collected and processed. This raises concerns about the privacy of individuals and organisations. Accountants and firms must ensure they comply with data protection regulations and respect the privacy rights of their clients. While Industry 4.0 can enhance transparency in accounting processes, it can also be manipulated to present misleading financial information. Ethical considerations demand that accountants use these technologies to improve transparency and not to deceive stakeholders.

- **The implications of algorithmic-based decisions in accounting.**

Algorithmic-based decisions can bring significant benefits to the accounting profession but, they also present new challenges that need to be carefully managed. Accountants need to understand the workings of these algorithms, their limitations, and their ethical implications to use them effectively and responsibly.

7.6 Implications of the study

Industry 4.0 has an influence on how firms are managed. Management determines the failure or success of Industry 4.0 implementation because it necessitates the acquisition of new competencies, new cultural norms, and the realignment of the organisation's strategic plan as well as the modification of the management structure. Consequently, leadership needs to be actively involved in assisting the process of digital transformation. Industry 4.0 can only be successfully implemented with the proper resource allocation and the backing of top management. The underlying transformations brought about by Industry 4.0 have a considerable influence on the duties of management across all industries, particularly in the accounting sector. Some conventional management practices, such as face-to-face meetings are becoming obsolete in today's digital economy, thus affecting management. In addition, real-time information and automation considerably influence accounting practices that were traditionally dependent on historical data. For instance, the coronavirus outbreak has amplified the trend toward remote work, which in turn necessitates the development of novel approaches to managing employees who do their jobs from home using modern technology. Many accounting duties are likely to remain the same, but as the nature of work evolves, the question becomes whether managers possess the competencies necessary to motivate, correctly communicate, and offer leadership while leveraging modern digital tools in a remote setting.

Additionally, because Industry 4.0 is a multifaceted phenomenon, it has led to the emergence of new jobs, which indicates new duties for accountants and management. Firm leadership must inevitably create a digital strategy in order to realise the full potential of Industry 4.0. Due to the ever-evolving nature of Industry 4.0 and the proliferation of new and innovative technologies, it is more important than ever to have a well-defined digital strategy. One could suggest that, given the ever-evolving nature of Industry 4.0, it is essential for accounting firms to regularly evaluate the effectiveness of the company's digital strategy and adapt accordingly.

7.7 Conclusion

This chapter presented the findings of the research and recommendations, as well as a brief overview of the relevant literature and limitations of the study. The aim of this study is to examine how accounting is influenced by Industry 4.0 with a view to understand how the accountants are preparing and responding to disruptions brought by Industry 4.0 and how it is affecting their operations and the opportunities it creates.

This research may benefit professional accountants, accounting firms, lawmakers, and academic institutions. The study may help accountants better comprehend how innovative technologies are disrupting the work of accountants and how their roles could change in the future in the business environment. In addition, accounting regulatory organisations may use the findings to improve their continuous professional development (CPD) programmes to provide prospective and current accountants with the essential skills to succeed in this evolving technological environment. Furthermore, academic institutions may consider the findings and, as a result, alter the academic curriculum to align it with the competencies and skills expected of new professional accountants.

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Appendix A. Editors' letter

The Dissertation Design Master

Phone: +27780248617
Email: mketiwae@yahoo.com
Email: saniphetinvestments@gmail.com
Web: https://thesis-reports-proof-reading-and-editing.business.site/

This is to confirm that the thesis entitled

EXAMINING HOW ACCOUNTING IS INFLUENCED BY INDUSTRY 4.0 IN KWAZULU-NATAL, SOUTH AFRICA.

Authored by

ALEXANDER MARKEY OLUKA

was edited according to Durban University of Technology's specifications.
The student received a detailed report with suggested changes together with their thesis with track changes. The thesis will be fit for submission when the student attends to all suggested changes (**that should be reviewed together with the supervisor**) and obtains permission to submit from the supervisor. This certificate does not warranty permission to submit if the supervisor has not agreed with the student.

Report prepared by:

Elizabeth Mnyandu

Signature over printed name

Date: 13 January 2023

Qualified Copy Editor

Contact Number
+27780248617

https://thesis-reports-proof-reading-and-editing.business.site/

Appendix B-F. Gatekeepers' letters

KPC3

PROFESSIONAL ACCOUNTANTS

Redefining the obvious

14 February 2022

To Whom it may concern.

Re: Letter of Authorisation

KPC3 international (Pty) Ltd has granted Alexander M Oluka permission to conduct research for his studies at Durban University of Technology.

We will assist Alexander Oluka with his research titled:
"Examining how accounting is influenced by Industry 4.0 in KwaZulu Natal, South Africa".

For any queries, please contact the office.

Yours sincerely

Shirley Ndlovu
HR Admin

1 | Page

MEMBER: K. PILLAY – B COM. Professional Accountant (SA) SAIPA FSF

Appendix C.

EQUITY ACCOUNTING CC
ACCOUNTING ADVISORY BOOKKEEPING TAXATION

CK 2001/034853/23
TEL - 031 488 4040
FAX - 031 488 4041
EMAIL - TAX@TAXSERVICES.CO.ZA
ADDRESS - 20A BEACH ROAD, BLUFF, 4052
PO BOX 21795, BLUFF, 4038
WWW.EQUITYACCOUNTING.CO.ZA

15 September 2022

To Whom It May Concern:

LETTER OF PARTICIPATION IN RESEARCH STUDY

This serves to confirm that Equity Accounting CC participated in the research study of Alexander M Oluka, titled:

"Examining how accounting is influenced by Industry 4.0 in KwaZulu Natal, South Africa."

I presume you will find the above in order, should you have any queries please do not hesitate to contact us.

Yours faithfully

DDD Bertrand- SAIPA, IAC.
Professional Accountant (S.A) & Financial Accountant In Practice (S.A) &
Certified Tax Practitioner (S.A)
SAIPA Prac No: 44890
Tax Practitioner No: PR-0104455

Appendix D.

UKUPHILA KWEZWE
ACCOUNTANTS

UMTHOLAMPILO WAKHO WEZIMALI | YOUR FINANCIAL CLINIC

5 WALNUT ROAD, DURBAN, 4001 | EMAIL: INFO@UKUPHILAKWEZWE.CO.ZA

18 August 2022

To Whom it may concern.

Re: Letter of Authorization

UKUPHILA KWEZWE ACCOUNTANTS has granted Alexander M Oluka permission to conduct research for his studies at Durban University of Technology.

We will assist Alexander Oluka with his research titled:

"Examining how accounting is influenced by Industry 4.0 in KwaZulu Natal, South Africa".

For any queries, please contact the office.

Yours sincerely
Ntando Phewa
Director
0788557096 / ntando@ukuphilakwezwe.co.za

Appendix E.

MVANO YETHU
ACCOUNTANTS & CONSULTANTS

+2731 825 3481
info@mvanoyethu.co.za
www.mvanoyethu.co.za
74 Samora Machell,
613 Wesley Centre, Durban

06 July 2022

TO WHOM IT MAY CONCERN

Re: Permission to Conduct Study

This letter serves as a confirmation that Mvano Yethu Accountants granted Mr Alexanda M Oluka permission to conduct his studies for research titled as "Examining how Accounting is influenced by Industry 4.0 in KwaZulu Natal, South Africa".

For any queries, please contact us.

Regards

Mrs.NS Mnyandu
Tax Practitioner (SAIT) PR-0087197
Accounting Officer – (SAIBA) - BAP (SA) 12621
Cell: 071 850 7659
Tel: 031 825 3481

MVANO YETHU ACCOUNTING
AND CONSULTANTS PTY LTD
613 Wesley Centre, 74 Samora Machel
Durban, 4001
Tel: 031 825 3480 Cell: 078 215 7708
South African Institute of Business
Accountant SAIBA
South African Institute of Tax
Pratitioners

Appendix F.

T: +27.31 447 1891| M: +27.78 240 4037
451 Main Road, 203 Premier Centre, Observatory, 7925

Reg No. 2016/371086/07 | VAT No. 4740289063

www.egreenaccountants.co.za

21 February 2022

Dear Sir / Madam

RE: CONFIRMATION OF CONDUCTING RESEARCH

RESEARCHER: ALEXANDER M OLUKA

E Green professional accountants have granted Alexander M Oluka permission to conduct research for his studies at Durban University of Technology.

We will assist Alexander Oluka with his research titled:

"Examining how accounting is influenced by Industry 4.0 in KwaZulu Natal, South Africa".

For any queries, please contact the office.

Regards

Teddy Nyamatuku, BAP (SA)
Professional Accountant (SA) |Tax Practitioner (SA)
CIMA | AICPA| SAIPA| SAIBA
SAIPA 53993| BAP(SA) 7696| PR-008617

Appendix G. Ethics clearance letter

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwin Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lawlahad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

5 April 2022

Mr A M Oluka
19 Sidmouth Avenue
Bluff
4052

Dear Mr Oluka

Examining how accounting is influenced by Industry 4.0 in KwaZulu Natal, South Africa.

I am pleased to inform you that Full Approval has been granted to your proposal.

The Proposal has been allocated the following Ethical Clearance number **IREC 050/22**. Please use this number in all communication with this office.

Approval has been granted for a period of **ONE YEAR**, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Prof J K Adam
Chairperson: IREC

Appendix H. Question schedule

Topic: Examining how accounting is influenced by Industry 4.0 in KwaZulu Natal

Section A

Demography

1. Which race group do belong African, White, Indian, Coloured, Other
2. What is your gender Male/ Female/Other?
3. What is your age group [20-30, 30-40, 40-50, 50-60, 60-65]
4. How many years have you been working in accounting?

5. What is your level of education [Matric (Grade 12), certificate, diploma, degree, Honours, Masters, PhD]?

Section B

1. How has the emergence of industry 4.0 been influencing accounting practices?

This can include but not limited to preparing financial statements, compiling reports, communication with stakeholders, real-time information gathering, continuous auditing using Blockchain, document storage, financial forecasting, risk analysis, preparing of accounts and tax returns?

What, in your opinion, are the opportunities presented by industry 4.0 in accounting. This can include but not limited to (labour cost, data processing, productivity, risk assessment, data storage, communication channels)?

2. What do you think are the key challenges presented by industry 4.0 on accounting? This can include but not limited to acquisition, regulations, privacy and security, employee's competencies, and legacy system.

3 Relating to Challenges, what are the cybersecurity risks associated with industry 4.0 implementation in accounting?

   a. What are the implications of cybersecurity breaches on accounting firms? This can include but not limited to (loss of revenue, reputational damage, operational disruption, and regulatory sanction, loss of confidential information, litigation costs, cost of replacing damaged equipment)

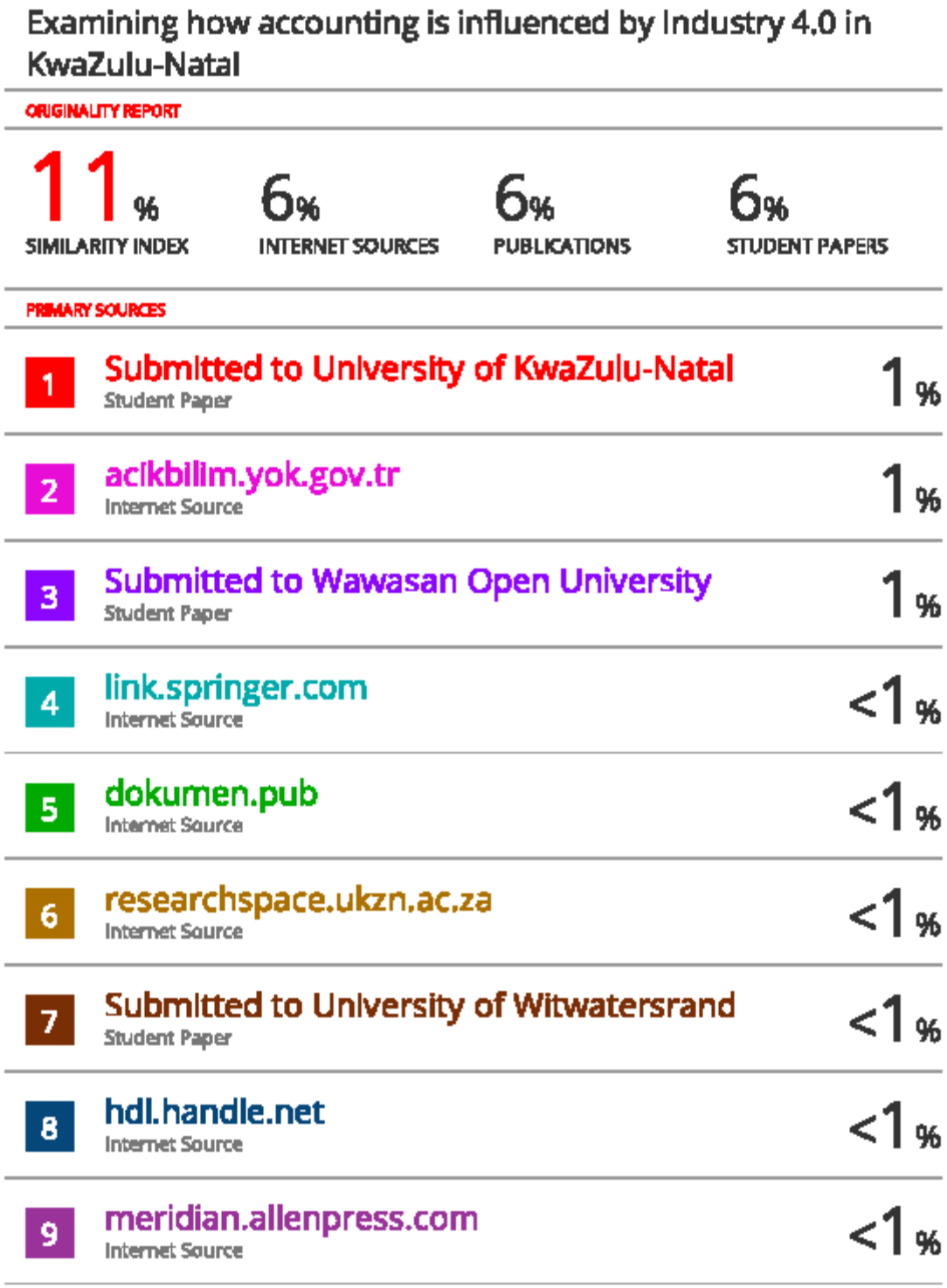
   b. How do accountants prevent, respond to, and recover from cybersecurity breach? This can include but not limited to (e.g., file backup, firewalls, system updates, encryption, antivirus, educating employees, login authentication, password, risk strategy, internal controls, staff training, cyber-security testing, Purchase cyber insurance, Cyber-security investments)

4 What are the primary factors that will influence accountants to implement and/or adopt new and innovative technology presented by industry 4.0? (This can be internal/external or both) This can include but not limited to (uncomplicated system, operating environment, compatibility, imitating industry leaders, business size, age of the business, legal requirements, employees' competence, infrastructure, and resources)?

5 What is your role as management/leadership in implementing industry 4.0 in your firm? This can include but not limited to (motivating employees, creating a vision for change, communicating change, planning for change, creating a conducive environment for change, getting employees' buy-in and leading staff by example)

6 What other recommendation can be made to promote the implementation of Industry 4.0 driven technology in the accounting firms?

Appendix I-J. Turnitin report



Examining how accounting is influenced by Industry 4.0 in KwaZulu-Natal

ORIGINALITY REPORT

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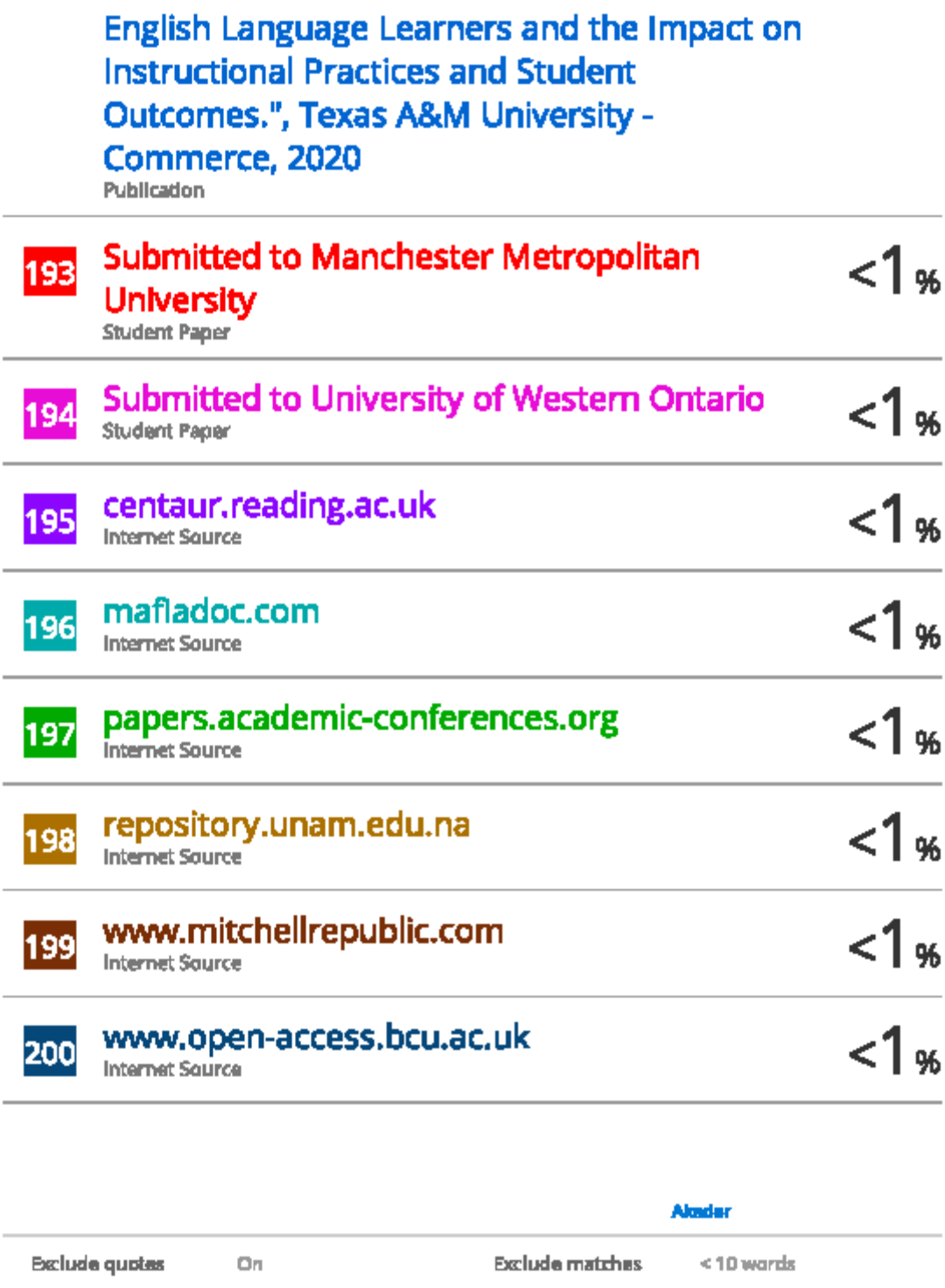
Appendix J.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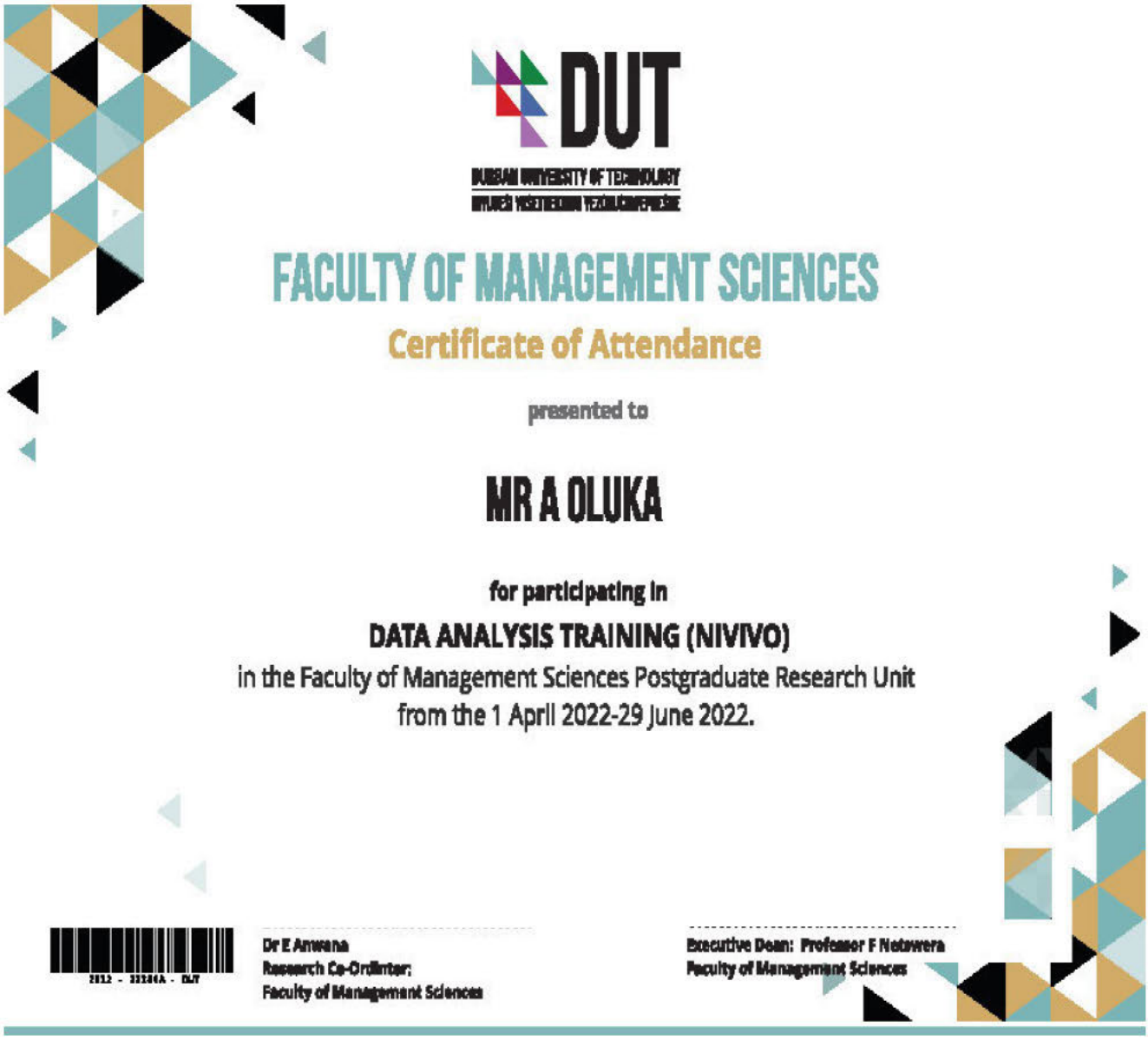
Appendix K. NVivo certificate of attendance



DUT

DURBAN UNIVERSITY OF TECHNOLOGY

FACULTY OF MANAGEMENT SCIENCES

Certificate of Attendance

presented to

MR A OLUKA

for participating in

DATA ANALYSIS TRAINING (NIVIVO)

in the Faculty of Management Sciences Postgraduate Research Unit
from the 1 April 2022-29 June 2022.

Dr E Anwana
Research Co-Ordinator:
Faculty of Management Sciences

Executive Dean: Professor F Ngobeni
Faculty of Management Sciences

2 June 2023

To whom it may concern

Re: Editing confirmation letter for Alexander M Oluka PhD thesis

This letter confirms that the undersigned edited the PhD thesis written by Alexander Oluka titled: Examining how accounting is Influenced by Industry 4.0 in KwaZulu-Natal, South Africa. The editing included grammar, spelling, numbering, pagination, punctuation and language consistency.

Sincerely

Misheck Musaigwa (PhD)
Mobile: (078 3688 703)
Postdoctoral Research Fellow