EXPLORING THE DIGITAL CAPABILITIES OF A PRIVATE UTILITY FOR SOCIETY 5.0 AT A SELECTED ORGANISATION IN THE WESTERN CAPE

by

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DECLARATION

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

Signed **Date**

ABSTRACT

While the systems that control the supply of electricity and other utilities to our homes operate with computerised automated controls, they operate under a limited scope of functionality, brought on by several factors, namely legacy systems, cybersecurity concerns, cost constraints, integration complexity, reliability and redundancy, human oversight, data and communication limitation, and skill shortage.

Given the problem narrative, the main objective of the research was to investigate the digital capabilities required by the private utility environment to participate and remain competitive in Society 5.0. In addressing the main objective, the main research question was to determine the digital capabilities of a South African private utility to participate and compete in Society 5.0. The research focused on the interpretivist approach to put forward the perceptions within the private utility environment that formed part of the study. The study conducted an investigation by means of participant observations and interviews conducted using a qualitative research approach. Owing to the selected qualitative approach, the study used purposive sampling, a non-probability sampling strategy frequently used in qualitative research.

KEYWORDS: Society 4.0, Society 5.0, Digital transformation, Digital workforce, Digital echnology, Smart communities, Digital infrastructure, Private utility

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Definition of key concepts

Society 4.0: is defined as "an information society that realises increasing added value by connecting intangible assets as information networks" (Salimova et al., 2021)

Society 5.0: is defined as "an information society built upon Society 4.0, aiming for a prosperous human-centred society" (Alhefeiti, 2018)

Digital transformation: This a term used broadly to describe the positive transformation of an organisation using digital technologies internally to streamline the operations for the benefit of the organisation and its customers.

Digital workforce: This refers to a variety of 4IR solutions and technologies that drive the efficiency and productivity in the workplace.

Digital technology: Digital technologies encompass electronic tools, systems, devices and resources used for generating, storing, and processing data.

Smart communities: Intelligently blending technologies, with the surrounding man-made settings, such as infrastructure, to enhance the quality of life for individuals residing, working or commuting in those areas.

Digital infrastructure: This is an infrastructure is without geographic limitation and the combination of physical resources, such as communication devices, computerised devices, the method and use of data, systems and processes.

Private utility: A publicly regulated utility provider is responsible for delivering water, electricity, sanitation, and gas services. This involves the management of physical distribution lines that are linked to privately owned properties but owned and operated by non-public entities.

CHAPTER ONE:

INTRODUCTION AND BACKGROUND

1.1 Introduction

The field of information and communication technology (ICT) is advancing quickly, leading to transformations in both societies and industries. As an example, the concept of Society 4.0 focuses on leveraging ICT to enhance the productivity and efficiency of processes, ranging from production to logistics in the manufacturing sector (Demirel et al., 2021; Zengin et al., 2021). Digital technology, however, has since advanced us from the information society, which was centred on manufacturing, into a smart society, where data and information are key to shifting ideals from profitability to humanity.

In 2016 the Japanese government made a push, for the creation of a "Super Smart Society", also referred to as Society 5.0. Society 5.0 would be a human-centred society, merging cyberspace and the physical space (real world) to facilitate the collection of real-world data through digital communication (IoT) and utilising artificial intelligence (AI) to analyse the vast amounts of data obtained from consuming services to create a cyber model of society (Gurjanov et al., 2020).

The goal is to strike a balance between progress and addressing issues, while offering products and services that cater to specific needs, ultimately aiming to enhance the quality of life for individuals. This quality of life extends to education, transport, energy supply, medical care, among others; thus, these systems will gather a variety of data from the physical space, operating in a highly integrated fashion. The information gathered from these systems needs to be used in situations to influence human behaviour. This process aims to create a loop where data is gathered, studied, transformed, put into action and regularly fine-tuned (Olariu, 2020).

1.2 Problem statement

Several factors such as legacy systems, cybersecurity concerns, cost constraints, integration complexity, reliability and redundancy, human oversight, data and communication limitations, and skill shortage have limited the scope of functionality of the systems that control the supply of electricity and other utilities to homes in Cape Town. . With reference to Society 5.0, information systems must collect data, process it, and apply the results in a real-world environment but in a more integrated manner, and at a more granular level (Deguchi et al., 2020). The premise is to develop systems that can adapt, based on the effects of service delivery on society, and the impact on the environment, instead of pursuing economic growth at the cost of harming the planet.

Despite the advancements in control systems for power generation, these systems are not adequately delivering the required energy output, indicating significant inefficiencies in their operation (Järventausta et al., 2010). This issue is compounded by the sifting towards Society 5.0, which necessitates the integration of cyber and physical elements into interconnected systems rather than isolated entities. The digital transformation strategy set for Africa (2020–2030) requires Africa to have an inclusive digital society and economy to improve the quality and lives of the people in Africa (African Union, 2020). Society 5.0 requires continuous adaptations to the way we live, work and interact. In the private utility sector, solutions and service offerings evolve continuously with the changes of technological advancements brought on by these disruptive revolutions. Therefore, an urgent need to acquire new competencies and to build the digital capacity required to support these advancements (Sá et al., 2021).

1.3 Rationale and significance of the study

The current power supply problems within South Africa make it necessary to explore alternatives such as renewable energy supply and consumption strategies. Private companies in the utilities industry are getting ready for changes in the energy sector to stay competitive and stay ahead of the curve. Within the South African private utility industry organisations use some 4IR technologies. However, this study aims to explore what digital infrastructure is required for a private utility to benefit fully from Society 5.0.

The findings of the study will therefore benefit organisations within the private utility sector that are gearing themselves up for Society 5.0 by:

a) Providing guidelines on what is required to operate in a smart community within Society 5.0
b) Providing a framework to assess their readiness to operate and compete within Society 5.0

1.3.1 Contribution to the body of knowledge

This research will use literature and empirical findings to develop a readiness model, thereby contributing to the body of knowledge in respect of Society 5.0.

1.4 Aim and objectives of the study

1.4.1 The main objective of this study is

To explore the digital capabilities required by the private utility environment to participate and remain competitive in Society 5.0.

1.5 Main research question:

What are the digital capabilities of a South African private utility to participate and compete in Society 5.0?

1.5.1 Research sub-questions

- What digital infrastructure is required for a private utility to benefit fully from Society 5.0?
- What type of skills would the workforce require for a private utility to support a super smart society?
- How can private utility organisations assess their readiness for Society 5.0 innovation?

1.6. Overview of literature review

1.6.1. Introduction

Eskom provides close to 40% of electricity to Africa, and 90% within the South African borders, of which 10% is supplied to local municipalities, redistributors, and private generators (Ratshomo & Nembahe, 2021). Eskom's ageing and deteriorating infrastructure, however, has contributed to the continuous failure to keep the electricity on, and to the potential price increase of 40% for electricity for the first half of 2022 (Kamanzi, 2022). As such, it would be worthwhile to explore alternatives such as renewable energy supply and consumption strategies. Global efforts to implement renewable energy are gaining momentum as countries gear themselves up for cleaner energy alternatives in line with sustainable development goals (Ratshomo & Nembahe, 2021). Organisations worldwide look to transformation in the energy sector to adapt, thrive and maintain a competitive edge (Światowiec-Szczepańska & Stępień, 2022).

The arrival of renewable energy creates a great opportunity for the energy sector to undergo digital transformation through the use of new digital technologies. This feature is attractive to investors as it paves the way for innovative business models to thrive in this sector. A major contributor to this driving force of digital transformation is also the growing need and demand to provide customers with the convenience of how they consume products and services using advanced digital technologies (Światowiec-Szczepańska & Stępień, 2022). Society 5.0 aims to enhance human quality of life and social well-being by utilising technology and Big Data collected from monitoring behaviours to guide decision-making (Światowiec-Szczepańska & Stępień, 2022). The needs of individuals are catered for by providing goods and services if and when required, and in amounts necessary so that citizens are able to live their lives actively and comfortably (Shiroishi, Uchiyama & Suzuki, 2018). Society 5.0 fundamentally aims to deliver economic advantages to companies, individuals and communities collectively. (Gladden, 2019).

1.7 The future of utility providers within Society 5.0

The future of the energy industry will change drastically as it moves away from standardised services toward a more customised approach, unique to a specific community (Deguchi et al., 2020). As such, consumer privacy, industrial structure, employment and public administration are all areas of society that will be going through extreme changes, and digital information must make provision for these demands (Pereira, Lima & Santos, 2020). In many countries, digital transformation is becoming a foundation of industrial policy. Industry 5.0 can be seen as an opportunity for a renewed human-centric industrial shift, starting with organisational, structural, managerial, philosophical, cultural and knowledge-based changes to restructure processes to impact the organisational and innovation ecosystem positively (Carayannis & Morawska-Jancelewicz, 2021).

In the current utility environment, components of digital infrastructure are perceived as commodities utilising billing and consumption data extracted from various systems and monitoring devices, with human intervention, with a potentially high risk of human error and delays in production in terms of reporting. However, digital infrastructure should be seen as a way of conceptualising interconnected systems collectively, rather than hardware components and standalone systems in isolation, collecting raw data from the real world, and storing it in virtual "factories for Big Data" that monitor and update systems continuously (Queiroz, Tallon & Coltman, 2020).

The infrastructure to maintain this requires a variety of computer sensor networks, automation technologies and cloud computing using various types of integrated systems, hosted and consumed via cyber-physical space, which will allow for metering and billing customers to pay as they consume (Deguchi et al., 2020; Olariu, 2020). Blockchain can integrate the entire transaction history, reducing operational and transactional cost through automation of post-trade reconciliation, providing a platform for collaboration between various role players such as resellers, third-party organisations, etc. Also, for interoperability of operational data, it can provide transparency and efficiency in terms of billing and consumption data (Bansal & Burra, 2021).

The future of the energy industry means that the skills required by technical, support, and management teams are critical (Deguchi et al., 2020). According to a survey conducted by Deloitte in the US in 2020 (Smith, 2020), in six out of 10 engineering and construction firms, there was a growing need for new skills such as programming, data analytics and data sciences owing to the new technological infrastructure acquired. The demand for these new skill sets puts industrial and energy companies at odds with technology and other industries for this talent (Smith, 2020). The new technologies result in many jobs being impacted with change and tasks are being carried out. Business management strategy and marketing require design skill to deploy technological projects, with highly skilled workers to operate and maintain these technologies (Gladden, 2019). Collaboration, adaptation, and innovation are what brings humans and technology together in Society 5.0.

While technology literacy enables the ability to use digital technology for processing information and data, human literacy is equally important as it brings the softer skills to compliment the human-centeredness promised by Society 5.0 (Salgues, 2018). In addition, strategic flexibility is key for organisations to adapt quickly to customers' needs, tweaking the strategic plan as they move forward to keep up with the rapidly changing environments (Demirel et al., 2021). The support of the management team is therefore vital to the success of digitisation within the energy sector (Światowiec-Szczepańska & Stępień, 2022).

Hence, a dearth of expertise and familiarity, paired with management's reluctance to adopt and implement these new technologies, may be a significant factor in determining the success or failure of digital transformation (Światowiec-Szczepańska & Stępień, 2022). However, what is required from utilities to succeed within Industry 5.0 is still unclear from a pragmatic standpoint. It would be worthwhile exploring this phenomenon empirically to provide guidelines for what is required by energy utilities to operate in a smart community within Society 5.0.

1.9 Overview of research approach and methodology

1.9.1 Research paradigm

A paradigm can be referred to as a theoretical framework, influencing the way knowledge is interpreted and studied. There are various research paradigms that can be applied, namely positivist/postpositivist interpretivism/constructivist, transformative and pragmatic (Alharahsheh & Pius, 2020). With the interpretivist/constructivist paradigm, the intent is to understand and experience the world from a human perspective, thereby enabling an in-depth understanding by asking *what, why,* and *how* questions about a particular phenomenon to understand and explore issues of influence (Deetz, 1996; Mackenzie & Knipe, 2006); thus, suitably aligning to the objectives of this research. This study will employ an interpretive paradigm by using theory to guide the design of data collection using the conceptual framework (problem conceptualisation) developed based on an initial observation of the phenomenon using the literature (Mertens, 2009; Walsham, 1995).

1.9.2 Research approach

Two main approaches used in research are qualitative and quantitative methods. While quantitative research is undertaken through statistical testing and findings are presented in numerical form, aligning to a positivist research paradigm, qualitative research is particularly useful for underexplored phenomena and is particularly associated with an interpretive research philosophy that employs a naturalist approach in the study of a phenomenon (Domegan & Fleming, 2007). Considering the aspects of the research questions and the underexplored subject matter, opting for a qualitative method is seen as suitable, to achieve the research goals effectively. Qualitative research allows the researcher to perform an inquiry by interviewing and observing participants in their natural environment and the outcome of the information received should be a true representation of the perspective of the participants involved (Teherani et al., 2015).

1.9.3 Research design/strategy

The research design serves as the overarching structure that outlines how data will be gathered using research methods, including descriptive, explanatory and evaluative approaches (Leedy & Ormrod, 2019). The research plan outlines the required data, the methods, for collecting and analysing data, and how this information is used to tackle the research questions. Exploratory research generates new empirical data, thereby increasing knowledge and understanding of the phenomenon (Burns & Grove, 2001), thus suitably aligning to the fact that is an underexplored area of focus. When designing the questions, clear objectives must be set, so that when the data are collected, the research questions are answered. Therefore, an exploratory research design serves to answer the *what* and *how* questions of this research, and were employed at a selected private utility in the Western Cape as the case study (Rahi, 2017). The organisation was selected because of its use of advanced smart solutions and technologies for their water, electricity, gas and solar projects.

1.9.5 Demarcation/delimitation of study

Delimitations are the traits that not only outline the extent but also define the limits of the research problem (Teherani et al., 2015). The researcher establishes these limits to prevent the research goals and objectives from becoming unattainable. (Theofanidis & Fountouki, 2018). The study is therefore limited to focusing on a private utility organisation and its employees based in Cape Town, Western Cape and only focuses on answering the research questions to achieve the objectives of the study.

1.9.6 Research population

The research population is typically the target or focus group to be identified, and on which the research is based. The parameters defining the population to be included or excluded from the study need to be articulated clearly from the outset.(Banerjee & Chaudhury, 2010). The population for this study constituted a selection of permanent and contract employees who must at least have worked in the organisation for three months or more. The respondents should also have the relevant work experience within their position or prior work experience within the private utility environment. The population of the study constitute all staff working in the Management Team, IT, Customer Solutions Centre, Solutions Technical Centre, Finance Department, Project Office and Operational Support only. These staff would suitably align suitably to contributing to the theoretical stance of this study, as guided by their relevance to the problem conceptualisation.

1.9.7 Sample method

There are two kinds of sampling methods: probability sampling and non-probability sampling (Shukla, 2020). Owing to the qualitative approach selected, non-probability sampling was utilised for this research. For this study purposive sampling was used, which is a common non-probability sampling method often employed in qualitative research. (Alkassim et al., 2016). The sample was chosen based on the researchers‘ judgement, and selection of the target group to participate in the research was guided by the problem conceptualisation in order to obtain rich data, given the underexplored focus of the research (Bernard, 2002). Typically, purposive samples are used in non-probabilistic sampling methods where the sample size is determined by saturation or reaching a point where no new data or themes emerge from the collected data. (Guest, Bune & Johnson, 2005). The focus of the study was limited to the organisation's Cape Town offices, with the sample size consisting of about 50 employees, including management.

1.9.8 Data collection instruments

There are various instruments that can be used to gather empirical data, such as questionnaires, case studies, interviews, focus groups and observations (Daniel, 2016). The selection of a data collection instrument is crucial because it should be helpful in collecting information to support or be able to answer the research questions (Canals, 2017). Interviews are considered crucial, for gathering data especially because they provide insights, into underexplored phenomena (Qu & Dumay, 2011). Information will be gathered through semi-structured interviews that utilise predefined questions, as a guide forming an integral part of in-depth one-on-one discussions. (Canals, 2017). The interview questions were developed through the lens of problem conceptualisation. Therefore, there is structure in relation to themes that guided the development of the questions, but the questions are still largely open-ended to allow for the collection of in-depth views on the phenomenon.

1.9.9 Data collection/fieldwork

Collecting data and developing a strategy for data collection are crucial in improving the depth and quality of a social research project (Rimando et al., 2015). Therefore, based on the strategically selected sample, key strategic stakeholders from the organisation were consulted via email to confirm their participation as part of the study.

The interview guide was submitted for ethics clearance for approval and consent was obtained from the organisation under study before participants were approached to participate in the study. Interviews were booked timeously with a limited timeframe of 60 minutes per session. One-on-one interviews were conducted with the staff constituting the sample. The researcher therefore became the data collection instrument and played an important role in gathering information and understanding the reasons behind specific events by employing probing and follow-up questions (Teherani et al., 2015). The interviews were recorded and the transcription of these recordings were utilised for analysis at a later stage of the study.

1.9.10 Data coding and analysis

The interpretive paradigm selected, and the resultant qualitative approach of the research necessitated the use of content analysis, guided by the problem conceptualisation as a lens for the exploratory discovery of codes, while guided by the themes of the conceptual framework. When coding the participants' feedback, labels were assigned to words and phrases that have recurring themes in case of importance, since this aligns to the overarching themes of the framework. ATLAS TI programme was utilised for coding. The recommendation to ensure coding credibility is to share research transcripts and reports with participants to ensure accurate representation of information provided during the interviews (Butina, 2015).

1.10 Overview of ethical consideration

Ethical considerations and principles always need to be applied and adhered to. Before starting the data collection process we will ensured that approval and written consent was obtained, from both the organisation and the employees. It is important to secure approval beforehand as it can be challenging to obtain it after (Fleming & Zegwaard, 2018). The interviewer discussed the content of the questionnaire and briefed the participants on the interview process. Participants received a reminder that they had the option to opt out of the study at any point ensuring that all information shared during the interview remained confidential and their identity would be kept anonymous with no personal details being disclosed.

1.11 Limitations of the research

The researcher may limit their findings based on the participants being interviewed rather than generalising (Daniel, 2016). The study is limited to one organisation and its employees within the private utility industry. The study results focus on the questions posed during the interview, considering that participants might have a limited understanding and background on the subject.

1.12 Outline of the dissertation

Chapter One: Introduction and background of the research

This chapter introduced the problem and why it is of importance. The research goals, purposes and questions were clearly defined, and a discussion of the contribution of the study, along with its constraints was presented.

Chapter Two: Literature review

This section will make use of existing literature to frame the problem by identifying gaps to be explored.

Chapter Three: Research methodology

This part will delve into a conversation about the chosen research paradigm, methodology and approach, highlighting how they connect to the research goals and the conceptualisation of the problem.

Chapter Four: Results/findings of the research

This chapter will focus on a discussion and detailed account of the analysis of the empirical data, and a discussion of the findings in relation to the preliminary review of literature and the resultant initial problem conceptualisation. From this, a refined framework will be produced, and answers to the research questions will be discussed.

Chapter Five: Conclusion and recommendations from the study

This chapter will consist of the conclusion and recommendations and would possibly identify areas not explored in the study.

CHAPTER TWO:

LITERATURE REVIEW

2.1 Introduction

In Chapter One we discussed the background of the study, the research methodology and the approaches needed to address the research questions and achieve the research goal.The objective of this chapter is to critically assess the debate on the topic and establish the study's significance.

This literature review intends to provide context by interpreting what is already known, based on the studies relevant to the research topic. Its main function is to identify gaps in the knowledge, which then gives a reason for conducting the research. (Fry, Scammell & Barker, 2017). The literature review was directed by the questions developed for the study. In addition, the research topic, including the limited literature globally and in South Africa on the impact of the research topic, justifies the research study conducted.

The following themes are discussed based on the available literature under the headings below:

- The future of utility providers within Society 5.0.
- What digital infrastructure is required for a private utility to benefit fully from Society 5.0?
- Digitalisation and digital transformation, smart grid, virtual power plants, microgrids, peer-2-peer trading, Blockchain, Big Data, loud computing, Fog and Edge computing, smart cities, home energy management systems (HEMs), building energy management systems (BEMs).
- What type of skills would the workforce require for a private utility to support a super smart society?

Eskom provides close to 40% of electricity to Africa, and 90% within the South African borders, of which 10% is supplied to local municipalities, redistributors, and private generators (Ratshomo & Nembahe, 2021). Eskom's ageing and deteriorating infrastructure, however, has contributed to the continuous failure to keep the electricity on, and to the potential pricing increase of 40% for electricity expected for the first half of 2022 (Kamanzi, 2022). It might be an idea to consider other options, like using renewable energy sources and adopting different consumption tactics. The adoption of renewable energy is being pushed globally as countries ready themselves for cleaner energy alternatives in line with sustainable development goals (Ratshomo & Nembahe, 2021).

Organisations around the world are getting ready for transformation in the energy industry to stay competitive and stay ahead of the game (Światowiec-Szczepańska & Stępień, 2022). The rise of renewable energy presents an opportunity for the energy industry to embrace digital transformation. This shift has caught the attention of investors, thanks to emerging technologies and innovative business models in the sector.

A major contributor to this driving force of digital transformation is also the growing need and demand to provide customers with the convenience of how they consume products and services using advanced digital technologie (Reinartz, Wiegand & Imschloss, 2019). Drawing from (Światowiec-Szczepańska & Stępień, 2022), Society 5.0 aims to prioritise the well-being and quality of life of individuals by leveraging technology and Big Data through observing behaviours to guide decision-making processes.

The needs of individuals are catered for by providing goods and services if and when required, and in amounts necessary so that citizens are able to live their lives actively and comfortably (Shiroishi, Uchiyama & Suzuki, 2018). Essentially, Society 5.0 aims to enhance the economies of businesses, individuals and communities at large (Gladden, 2019). In Society 5.0 individuals will perform the central roles in day-to-day living, with energy systems uniquely developed to each local community. All of these developments are speeding up the transition from conventional electricity power systems, which rely on a variety of power sources, to new systems that incorporate a deeper integration of renewable energy sources, motorisation, digitalisation, diversification, and electrification.

The integration of renewables and developments of ICT, globalisation and changes in the values of people, combined with other factors, has led to radical changes in the economy, as well as in industrial structures and social frameworks. Hitachi in Japan is supporting suggestions for upcoming energy systems to back Society 5.0, and this could have an effect on the energy sector (Hitachi-UTokyo Laboratory, 2020). In the upcoming parts of this chapter, we will explore particular themes identified to fill in the gaps in the current literature. Every section and subsection has been meticulously selected to illuminate essential elements of the shift towards Society 5.0 and its impact on the energy industry. Exploring areas like the future of utility providers, digital infrastructure needs, workforce capabilities, and the wider digital transformation in the energy industry. The intent is to address knowledge gaps and offer valuable perspectives on the challenges and possibilities arising from this changing environment. The conversations are crucial for comprehending the intricacies of the energy sector's evolution within the framework of Society 5.0 and for guiding the development of tactics that can drive sustainable and innovative approaches to energy provision in the future

2.2 The future of utility providers within Society 5.0

Investigating how private utilities have evolved in connection to Society 5.0 reveals themes and noticeable gaps that come to light. Bringing in new technologies and integrating with existing legacy infrastructure poses difficulty with associated costs and disruptions. The problem of transitioning to a more advanced, sustainable, and customer-centric utility within Society 5.0 highlights critical areas where current systems fall short and where targeted efforts are needed to achieve the envisioned future. With these advancements within the energy sector, bulk power systems and local community energy systems will not be playing a standardised role, as they need to be structured in such a way as to be able to coexist. Currently, the entire power grid is controlled by bulk power systems; however, in the near future, more and more local communities will have their own power systems using renewable energy and other types of energy sources allowing them the ability to produce and consume power locally to improve their resiliency. The future of the energy industry will change drastically as they move away from standardised services toward a more customised approach, unique to a specific community (Deguchi et al., 2020).

As such, consumer privacy, industrial structure, employment and public administration are all areas of society that will be going through drastic changes, and digital information must make provision for these demands (Pereira, Lima & Santos, 2020). In many countries, digital transformation is becoming a foundation of industrial policy. Industry 5.0 can be seen as an opportunity for a renewed human-centric industrial shift, starting with organisational, structural, managerial, philosophical, cultural and knowledge-based changes to restructure processes to impact the organisation and innovation ecosystem positively (Carayannis & Morawska-Jancelewicz, 2021).

In the current utility environment, components of digital infrastructure are perceived as commodities utilising billing and consumption data extracted from various systems and monitoring devices, with human intervention, with a potentially high risk of human error and delays in production in terms of reporting. However, digital infrastructure should be seen as a way of conceptualising interconnected systems collectively, rather than hardware components and standalone systems in isolation, collecting raw data from the real world, and storing it in virtual “factories for Big Data” that continuously monitor and update systems (Queiroz, Tallon & Coltman, 2020).

The infrastructure to maintain this requires a variety of computer sensor networks, automation technologies and cloud computing using various types of integrated systems, hosted and consumed via cyber-physical space, a connected environment where physical activities blend seemlessly with technological advancements, which allows metering and billing customers to pay as they consume (Deguchi et al., 2020; Olariu, 2020). In addition, blockchain can integrate the entire transaction history, reducing operational and transactional costs through automation of post-trade reconciliation, providing a platform for collaboration between various role players such as resellers, third-party organisations, etc., and for interoperability of operational data, providing transparency and efficiency in terms of billing and consumption data (Bansal & Burra, 2021).

The future of the energy industry means that the skills required by technical, support and management teams are critical (Deguchi et al., 2020). According to a survey conducted by Deloitte in the US in 2020 (Smith, 2020), in six out of 10 engineering and construction firms, there was a growing need for new skills such as programming, data analytics, and data sciences owing to new the technological infrastructure acquired. The demand for these new skill sets puts industrial and energy companies at odds with technology and other industries for this talent (Czako, 2020).

The new technologies result in many jobs being impacted with change and the way tasks are being carried out. Business management strategy and marketing require design skill to deploy technological projects, with highly skilled workers to operate and maintain these technologies (Gladden, 2019).

Collaboration, adaptation and innovation is what brings humans and technology together in Society 5.0. While technology literacy enables the ability to use digital technology for processing information and data, human literacy is equally important as it brings the softer skills to compliment the human-centeredness promised by Society 5.0 (Salgues, 2018). In addition, strategic flexibility is key for organisations to adapt quickly to customers' needs, tweaking the strategic plan as they move forward to keep up with rapidly changing environments (Demirel et al., 2021).

The backing of the leadership group is crucial for the advancement of digitalisation in the energy industry (Światowiec-Szczepańska & Stępień, 2022). Therefore, insufficient expertise and experience, and the unwillingness of management to embrace and introduce these new technologies could potentially be one of the biggest contributors to the failure or success of digitisation (Światowiec-Szczepańska & Stępień, 2022). However, what is required from utilities to succeed within Industry 5.0 is still unclear from a pragmatic standpoint. It would be worthwhile to explore this phenomenon empirically to provide guidelines on what is required by energy utilities to operate in a smart community within Society 5.0.

2.3 What digital infrastructure is required for a private utility to benefit fully from Society 5.0?

Utility companies have been evolving and have started to move away from traditional utility activities. These utility organisations have started branching into private utility industries, some moving towards offering a hybrid service with traditional and renewable energy to their end consumers (Abegg & Baumann, 2022). The drive towards renewable energy has also accelerated the pace at which utility organisations restructure and align their organisation. Many of these utilities are working towards complying with decarbonisation, trying to remain reliable and cost effecient, but also trying to boost renewable energy, whiile organising activities between traditional and renewables makes it difficult.

The driving force of SDG is unquestionable, especially the global challenge that is put forward for countries to attain carbon emissions that are net zero by 2050 with a significant focus on clean renewable energy sources. This would require countries to adapt to the most technically feasible, socially acceptable, yet cost-effective interventions to be implemented by various stakeholders within organisations such as governments, investors, citizens and businesses alike to align with the latest report set out by the International Energy Agency (Brent, 2021). Countries worldwide are increasingly focusing on energy sources to reduce carbon emissions and achieve carbon neutrality by 2050. These efforts align with the goals of Society 5.0.

Under the federal energy strategy framework, utility companies in Switzerland are anticipated to make contributions towards boosting renewable energy and energy efficiency by 2050. By 2050, 48 of the 55 large investor-owned utilities in the United States have also pledged to decrease carbon emissions. On the African continent and in line with the UN's vision and SDGs for 2030, Botswana is also looking at alternative cleaner energy sources and to electrify over 40% of its population living without electricity (Prasad & Samikannu, 2018.).

In South Africa, Cabinet has approved private sector participation within the electricity industry, by which future power generation will be shared between Eskom (70%) and Independent Power Producers (30%), also bolstering the idea of clean energy (Ratshomo & Nembahe, 2021). A large number of researches have been focusing on reviewing power policies within South Africa, but few individuals have evaluated the effectiveness of policies aimed at promoting (RE) renewable energy power generation (Winkler et al., 2021).

The move towards renewable energy has been accelerated, embracing various systems, technologies and digitisation owing the disruptive nature of the fourth industrial revolution (4IR). The energy sector has not been spared in this regard and has equally been impacted as many of the other industries, in particular the manufacturing industry, are highly dependant on energy resources (Apata, Adebayo & Ainah, 2021). Technologies of 4IR have played an important role and are said to have contributed to the reduction of energy consumption, increasing energy efficiency during the production phase, positively impacting the reduction of energy expenses, maintaining energy security as well as protecting the environment (Saniuk, Grabowska & Grebski, 2022).

Access to and the availability of energy play a role in driving the social progress of any nation. These factors are also components of the Sustainable Development Goals (SDGs) that have been established (Ayamolowo, Manditereza & Kusakana, 2022.). With the energy sector being at the heart of economies, an increasing number of smart devices, sensors, and other smart technology fuel the rising demand for energy. Changes in energy pricing are observed to be impacted not only by organisations but also by countries and international policies. The energy sector's strategies and the need for various digital technologies could potentially meet the growing energy needs and facilitate the shift towards cleaner, more sustainable and renewable energy solutions (Trzaska et al., 2021.).

2.4 Digitilisation and digital transformation

Digitalisation is the major driver of change within the energy sector, driving and influencing business models and innovation (Akberdina & Osmonova, 2021). The sector is being transformed by disruptive forces and many of the leaders within these organisations are planning their digital drive on the bases of the impact these forces could potentially cause. The internet and smart embedded systems are also another major driver for ICT technologies within the energy sector. An essential initial move to enhance system effectiveness is embracing digital tools promptly, like blockchain, cloud computing, machine learning and robotic process automation, as highlighted by managers (Światowiec-Szczepańska & Stępień, 2022).

Digital tranformation can be charactarised by organised changes built on the foundation of technological advances. Businesses are shifting towards utilising social media platforms, Big Data, analytics, cloud computing and mobile communication technologies to provide personalised goods and services to their customers. This phenomenon is also referred to as digital transformation. Digital transformation can also be viewed as a means of transforming organisational structures, business procedures, and cultural norms to satisfy shifting consumer demands brought on by digital technologies. (AlNuaimi et al., 2022).

Business environments and operations are experiencing growing changes owing to the persistent and consistent growth of digital transformation technologies. The integration of the internet artificial intelligence (AI) blockchain, Big Data and other technologies, with changing consumer needs has been influenced significantly by the pandemic. Consequently, adjustments to or the lack thereof in corporate processes have become troublesome (AlNuaimi et al., 2022.). Digital transformation with the adoption of business strategy development aligning with these changes allows business to be more agile to conversions and the flexibility to adapt to customer individual needs, yet still aligning with the value network of each other (Trzaska et al., 2021.)

Digital public infrastructure is another key factor aiding digital transformation inside organisations as well as across organisations. Connectivity, on the other hand, is more valuable than infrastructure as it allows connections to and within a network environment, enabling knowledge flow to boost an organisation's competitive advange. From an organisational perspective, connectivity infrastructure positively impacts ICT comprehension as well as the level of integration of digital technoloiges, for example, electronic information sharing, Big Data, cloud computing and social media (Zoppelletto & Orlandi, 2022.).

Threats to utility organisations come from digital pioneers such as Tesla Motors, Amazon and Google as they are most noticeable at the customer interface, with information becoming more and more inportant, more so than material assets. Similarly, digital capabilities allow utility organisations to venture into new business arenas, either alone or with partnerships (Booth, Mohr & Peters, 2016.).

In Society 5.0 the focus is on consumers with the Internet of Things (IoT) addressing consumer related issues. It also contributes significantly to the wider digital transformation, which is transforming many aspects of the supply chain and value chain elements of the wider ecosystem into digital ones. Among the benefits of smart grid and Internet of Things-enabled services and operations are opportunities that drive data management, plant effectiveness, maintenance, and the transmission and distribution of supplies. Thus, the digital revolution is changing the power industry. Distributed generation, renewables and smart grid need new capabilities and skills, and are triggering innovative business models and regulatory frameworks.

2.5 Smart grid

There are interpretations of the term *smart grid,* encompassing advanced technological and institutional progressions aimed at enhancing the efficiency, intelligence and environmental friendliness of the power grid. (Yu, Yang & Chen, 2012). A smart gird is a novel generation of an energy netwoking system founded on outdated energy grid systems and utilising communication technologies, renewble energy, innovative materials, advanced sensor technologies, and energy storage technologies. An automated electrical grid, sometimes referred to as a smart grid, is a significant development in the infrastructure of electrical grids, using cutting-edge ICT technologies to provide real-time power distribution optimisation, control, and monitoring. Improving grid intelligence and resilience contributes to increased electricity supply sustainability, dependability and efficiency, which facilitates the transition to a future with more decentralised and renewable energy sources. Energy conservation, increased social and economic value, improved grid reliability, and decreased energy consumption are the objectives of the smart grid. (Chen et al., 2021.).

The innovativeness of technology is crucial in driving energy transition, integrating ICT with energy networks. Automation of the development of cutting-edge technologies like smart grids, smart grid systems, and energy storage is made possible by the digital transformation occurring in the renewable energy industry. A smart grid is a wide-area (macro) grid; it is an electrical grid utilising IT within a power supply facility with the means to optimise energy supply, linking energy demand and supply in an information network. (Deguchi & Kamimura, 2020).

Consistent with the Sustainable Development Goals, smart grids have become more prevalent with the application of these 4IR technologies in a smart grid framework, seamlessly integrating with renewable energy. Its purpose is that it is used for energy efficiency and optimisation, allowing IoT to take industrial and sustainable characteristics and naming it Green Industrial internet of Things (GIIoT) (Tabaa et al., 2020).

The overall characteristics of the smart grid and its distribution-level features were cdetermined in a prior study (Paul et al., 2014). The enhancements encompassed combining distributed power generation with management of the distribution network, the use of automated meter reading (AMR), power quality monitoring, the use of power electronics in the distribution of electricity, the use of plug-in vehicles as a component of smart grids, and incidence-based load control as an illustration of interactive customer gateways (Yu et al., 2012). The key to efficient use of DERs are through applying smart grid technology. Smart grid offers quality power meeting 21st century high demand, thus complying with proposed generation and storage options that meets customer needs owing to challenges and changes. To establish an operational environment where both parties, such as utilities and energy customers, influence one another, the main objective of the smart grid is to encourage consumers to participate and to make decisions. (Phuangpornpitak & Tia, 2013).

A smart grid has three functions: first, the grid is revolutionised through automation, remote control and monitoring, self-healing designs, and microgrids. Smart grids provide many advantages, for example, a more seamless approach to the integration of renewable energy, increasing energy efficiency, and customer experience giving them the power to make informed decisions. Advanced technologies, like automation data analytics and the Internet of Things are used in smart grids to enhance energy management, making it more efficient and reliable for both consumers and the broader energy ecosystem (Atasoy, Akınç & Erçin, 2015).

Communication technologies are necessary for smart grid devices since they connect to the utility organisation's head-end systems via Ethernet, Power Line communication (PLC), 3G/4G/5G, and fibre optics. This permits the two-way flow of information and electricity, and digital communication technology offers the capacity to recognise, react and take preventative action in response to variations in energy usage and other problems. With this the reliance on coordination of activities is extremely important for the systems to function optimally. The availability of user consumption data allows the ability to adapt electricity consumption patterns, to be able to achieve financial reward, or to improve sustainability and energy saving. (Avancini et al., 2019.).

The bi-directional control of physical movement in smart grids has steadily improved system effectiveness and the coordination of resources. Many authors have discussed the future of the smart grid, dubbing it the “energy internet” as it uses connections and cloud computing for linking energy sources, interdependence and extensive data analysis. The evolution of numerous systems, like virtual power plants (VPPs) or Vehicle-to-Grid (V2G) to name a few, is occurring via smart grids (Ahl et al., 2020).

With the emergence of distributed energy resources (DERs), such as distributed renewables, energy storage and controllable loads, disruptive transformation on centralised power systems is significantly impacted. A paradigm shift to decentralised power systems with bi-directional power flow is required for the integration of (DERs). A effective approach for handling distributed energy resources (DERs) to enable their involvement in the power grid is through a virtual power plant (VPP) (Yang et al., 2021).

2.6 Virtual power plants (VPP)

Virtual power plants have gained traction in smart grid-type applications that gather aggregate DERs in a coordinated portfolio. They are primarily utilised for assisting grid operators with grid support services and engaging in energy trading within energy markets (Van Summeren et al., 2020.).

A VPP can also be defined as a cloud-based platform by which DERs are aggregated (Rouzbahani, Karimipour & Lei, 2021). Energy storage, ICT, and generation units make up virtual power plants. The generation technology of virtual power plants is made up of DER portfolios, namely supply-and-demand response, while the supply-side in DER portfolios are distributed generation units (Ma, Billanes & Jørgensen, 2017). VPPs are a cluster of DERs, a group of storage units, manageable loads working together as a power plant.

Virtual power plants (VPPs) are thought to be beneficial for improving energy efficiency in smart energy networks and tackling decarbonisation aligned with the objectives outlined in the Sustainable Development Goals (SDGs). This entails overseeing and arranging regional energy resources, including production, use and storage. Virtual power plants aim to tackle challenges such as the availability of energy storage devices and insufficient local energy adaptability on the consumer side, and the erratic behaviour of energy sources (Goia, Cioara & Anghel, 2022.). The energy efficiency goals of the smart energy grid and decarbonisation are thought to be promisingly addressed by VPPs.

2.7 Microgrids

To be able to sustain the complex and rapidly growing energy demand, the traditional grid is incorporated with communication technology, namely smart grids, such as advanced metering with sensors, energy system storage (ESS), and demand response (DR) with the inclusion of electrical vehicles (EV). Microgrids are distribution systems operating at low to medium voltage levels featuring operational capabilities. These systems facilitate the transfer of energy among the grid-situated power generators and end users, through advanced energy management technologies (Vuddanti & Salkuti, 2021).

The utilisation of renewable energy resources, for example, wind, solar, etc., have led to a new concept, namely “prosumers”, which are energy consumers who also have the ability to become energy producers as they are able to sell electricity back to the grid that isnot being used. Entities of this type form microgids, described as localised grids that have the ability to connect and disconnect from what is known as traditional grids in the event of “islanding”. When distributed energy resources (DERs) provide power to customers inside a smart city during load shedding or other situations where the main grid or traditional grid is unavailable, islanding benefits both prosumers and consumers (Atasoy et al., 2015).

A reduction in the cost of renewable energy technology alongside emerging electricity network designs like microgrids play a vital role in transitioning towards distributed energy systems. (Ahl et al., 2020). The rise of generation from distributed renewable energy sources, along with its fluctuation and lack of control, poses difficulties for the existing energy infrastructure. Maintaining the equilibrium between production and consumption becomes equally important. Consumers and prosumers can consider trading self-generated energy directly on microgrid energy markets, using a peer-to-peer approach (Mengelkamp et al., 2018).

2.8 Peer-2-peer trading

Traditionally, electricity users, whether small businesses or households, would purchase electricity from a utiity service provider. Owing to the expertise required in the field of energy and engineering and the specialised serivces that are being offered, these service providers would traditionally act as the link between the electricity generating organisation and the user, giving them the power to negotiate pricing charged to the end users. This situation has slowly started to change with the increased adoption of microgeneration, for example, the production of electricity or heat on a micro or smaller, local scale, by which domestic energy producers are more actively involved (Murkin, Chitchyan & Byrne, 2016).

Peer-2-Peer (P2P) electricity trading is an interconnected business model, for example, an online platform creating a marketplace between prosumers and consumers, trading electricity at an agreed price without the interference of an intermediary service provider. DERs allow consumers to become active in the process of generating and distributing energy, becoming prosumers, meaning that they both produce and consume electricity in the process. This allows them the opportunity to share the benefit of generating electricity within the local community to which they belong (Masoudi, Dahmardeh Ghaleno & Esfandiari, 2020).

TTP plc (TTP), a leading technology and product development company, have come together in partnership with ME Solshare Ltd (SOLshare), a social organisation in Bangladesh. They manage smart peer-2-peer microgrid systems across Bangladesh and also India, focused on rural communities, enabling real-time trading of electricity generation using solar energy. The SOLbox platform has created a peer-2-peer microgrid trading platform for the distribution and trading of solar electricty among one another, providing users the opportunity to generate a direct income selling excess electricity to neighbours. The organisation currently manages 28 microgrids and aims to have 160 microgrids by the end of 2020 (Fairley, 2018).

Smart meters enable distributed energy systems; however, the network security for smart meters is minimal owing to legacy encryption methods leaving the meters exposed and easily tampered with. There is a growing concern from a social perspective about security and privacy in the context of modernising power grids and energy systems (Ahl et al., 2020).

To establish and facilitate peer-2-peer trading of electricity, several steps need to be taken.

2.8.1 The verification of micro-generated electricity, with the generation time and amount recorded. This is necessary owing to the changes in the price of electricity over time, based on demand and supply.

2.8.2 Traceability and auditability of transactions are necessary in order to calculate electricity bills accurately between electricity suppliers (domestic, etc.)

2.8.3 Only one unit token per unit of electricity must be represented on the network

Blockchain technology is widely acknowledged as the solution for tackling the aforementioned problem because it offers a distributed ledger that logs transactions securely in a way that cannot be changed. (Murkin et al., 2016).

2.9 Blockchain

Blockchain is an expanding collection of records, known as blocks, that are safeguarded by interconnecting them and using cryptography. Each block contains a reference, to the preceding block, which includes a timestamp and transaction date. (Sarode et al., 2021). Blockchain is progressively becoming a gamechanger in all sectors in terms of how value is created and even how society functions at large. Blockchain technology can facilitate inexpensive peer-to-peer transactions and has improved security through the use of cryptography.

Three particular goals were achieved in a research study utilising blockchain technology to enhance the VPP energy management platform (Yang et al., 2021). An example is utilised to create a trustworthy, verifiable energy management system for the VPP. Using blockchain, which functions as a trusted computing machine capable of performing energy management algorithms, this replaces the conventional technique of centrally controlling VPPs, so doing away with the need for a central coordinator. It also offers a safe communication platform. Last, blockchain's digital currency serves as a valuable payment method for energy trading and rewarding network services (Yang et al., 2021). With the introduction of blockchain, Peer-2-Peer (P2) trading may be possible within microgrids, addition to electricity exchange through physical and virtual utility grid connections (Ahl et al., 2019).

Industry 5.0 blockchain technology and encrypted codes are essential in developing and executing real-time applications, establishing the basis for secure, effective, and cooperative systems across different fields. Applications moving from Industry 4.0 to Industry 5.0 show how industrial systems are continuing to evolve in a direction that prioritises innovation and human–machine interaction while also becoming smarter, more collaborative, and adaptive.(Rupa et al., 2021).

Internet of Things (IoT) devices are geared with various communication interfaces and also embedded processors that are connected to the blockchain layer. This layer manages the data from IoT devices and enables decentralised data storage (Silva et al., 2019).

A robust blockchain framework for Big Data encompasses various technical challenges and must be considered upon integration and deployment; however, data accumulations and data services of the Big Data collected can be managed effectively and securely by blockchain. The advanced technologies and decentralised and immutable ledger guarantee data integrity and Big Data analytics assists with better insights for valuable predictions for massive data accumulation (Deepa et al., 2022).

2.10 Big Data

Big Data denotes a volume of data that cannot be analysed using conventional methods owing, to its mix of structured and unstructured data types. Generally, Big Data applications obtain data from various sources, including blockchain, in various formats (unstructured data), which cannot be processed in its “originated” format (Deepa et al., 2022).

The challenges of Big Data can be resolved by blockchain and vice versa. Big Data accumulation and data services can be managed effectively and secured through the utilisation of blockchain, since the decentralised and irreplicable ledger with its advanced technologies guarantee data integrity as well as Big Data analytics providing better insight and better decision-making for Big Data accumulation. Although there is not a definition significantly focused on ‘Big Data’, it is evident in scientific and engineering fields, like computer vision, IoT data analysis, operations management and smart cities. The concept of Big Data is considered to be a wave of technologies and structures that are being explored to analyse large amounts of data and understand key aspects, like uncovering insights, fast processing, and conducting analysis (Deepa et al., 2022).

Data generation is happening at a historic pace. According to Villars et al. (2011), more than 1ZB of data was produced in 2010 globally. It is said that by 2014 that number would rise to 7ZB annually. The rise in this enormous amount of data is due to smart devices connected at the edge of the network, for example, IoT devices, embedded sensors, smart devices, smart cellphones, smart metering devices, tablet computers, and wireless sensor networks. etc.

In the past 10 years there has been a surge in worldwide data flow, particularly focusing on the phenomenon of Big Data. It is said that by 2025 the Big Data market will reach 229.4billion USD with a significant reduction in expenditure in certain industries, such as retail, healthcare, transport and logistics, media and entertainment, and manufacturing. Big Data is also another fundamental pillar of Society 5.0 to assist societies in becoming smarter in a data-driven way. Numerous technological, economic, innovative and societal benefits can be attributed to Big Data as it plays a role in evolving a regular city into a Smart City. Transitioning from Society 4.0 to Society 5.0 hinges on embracing the concept of a data-driven society recognising the pivotal influence data holds in shaping our future (Nikiforova, Alor & Lytras, 2022).

Industry 5.0 relies heavily on Big Data, which is thought to bring new ideas into organising principles. Developed nations aim to leverage Big Data to benefit from the opportunities presented by 4IR, which is largely driven by the application of Big Data. At the same time, emerging organisations within growing economies, including Chinese organisations, have also opted to utilise Big Data for value creation (Shamim et al., 2019). Organisations cannot depend solely on investments to give them a competitive advantage. Growing and developing their capabilities, which are not easily replicable, give them a competitive edge over their rivals. Having the ability to use Big Data in real time for the exact purpose of decision-making and to explore new business opportunities sets organisations apart from their peers who have not yet made the shift. Owing to the widespread use of mobile technology and embedded sensors, a large amount of this data production is happening at the network's edge, away from the data centre.

Big Data analytics has revolutionised security management by offering multiple dimensions, including access management, risk governance, network traffic, and compliance, securing and restricting access to valuable Big Data that is stored in the cloud (Kabanda, 2021). In the era of Industry 5.0, transitioning into digitalisation is essential to ensure that cloud resources, services and data accessible to external smart sensor networks are readily available. (Akundi et al., 2022). In order to accomplish the goals of Society 5.0, it is essential to combine data science, AI and Big Data, as R&D tools aiming to merge the realms of physical and cyber spaces. Data are collected from numerous sensor types found in physical areas and compiled using IoT (Narvaez Rojas et al., 2021).

Through the codification of habits, consultation and visualisation, as well as utilising services and sharing of information among peers for processing and storage in data centres, these smart technologies enable the ability to gather knowledge through observation of various roleplayers, including citizens, users, and third parties, even within an organisation itself. All things considered, utilising blockchain technology has several benefits that make it possible to analyse big information in real time. These benefits include boosting transparency, guaranteeing data integrity, permitting decentralised data access, automating processes, and enhancing security and privacy. With the help of these characteristics, analysts can use the enormous volumes of data produced in real-time to gain insight and make informed decisions.

2.11 Cloud computing, fog and Edge computing

Traditionally, corporate servers have always been the most popular place to store data. Subsequently, the cloud has become more advantageous mainly because it eliminates financial fees associated with servers, server rooms, services related to cybersecurity, utility licences and expensive electricity bills (Balon, Kalinowski & Paprocka, 2022). In our everyday lives we all make use of cloud computing, such as Microsoft Office 365, Dropbox, Gmail, etc. Cloud computing is considered for its ability to spread computing infrastructure resources over the internet using IT-based services.

Beacuse of the ability of cloud computing to enable centralised data processing, monitoring, and storage, most of the newest Internet of Things applications have already been put into place on platforms of this type. Over the next few years there is an expectation to see an increase in the quantity of connected IoT devices (Fraga-Lamas, Lopes & Fernández-Caramés, 2021). Society 5.0 will revolutionise connected living with unified systems providing fully automated end-to-end services by reducing energy consumption and transmission delay while transmitting data from end-devices to the cloud, addressing the demands of users within a society. These systems incorporate cross-sectional knowledge sharing, closely integrating the physical, cyber, and social world with the purpose of empowering connected living. (Ghosh et al., 2021).

In a smart society, AI adds intelligence to machines performing the task of providing recommendations and decision-making for end users. AI systems receive information from IoT nodes that are deployed, collecting data from sensors. In order for smart communities to become a reality, key components of digital technology, such as wireless sensor networks and more recently Edge computing, which is a modern version of sensor networks, are required (Farsi et al., 2020). The cloud is used to collect information, namely data, from various service providers in a central location making it easily assessable if and when needed (Erl, Puttini & Mahmood 2013).

This information is then transmitted to the cloud where it is processed by AI systems and an output is given/communicated to the end user. However, there is a concern that latency will hinder real-time Internet of Things systems from relying on cloud-based systems to respond promptly (Ghosh et al., 2021). Diverse types of Edge computing have been proposed, including fog computing, which is Cisco's suggestion for using devices, with low power capabilities located at the edge, along with cloudlets composed of processors performing intensive tasks (Fraga-Lamas et al., 2021).

Given the sheer number of linked devices and the anticipated growth in IoT devices, improper scalability of the cloud could become a hindrance. Owing to this limitation on the cloud, Edge computing attempts to relieve the cloud of tasks that are capable of being completed by devices situated directly at the edge of an IoT network. In preparation and making provision for infrastructure effectiveness and efficiency, a few key decisions need to be made regarding how data will be collected, how and where this data will be processed, for example, Edge, fog or cloud, and how frequently data should be sent to the cloud. According to Filelis-Papadopoulos et al. (2019), fog computing is a type of distributed computing paradigm that enhances the functions of cloud computing by reaching the network edge. This enables handling of data, analysis and decision-making, in proximity to where the data originates and is utilised. This architecture is particularly well suited for Internet of Things applications, smart city applications, industrial automation, and other scenarios requiring fast response times and low latency in data processing. By combining the advantages of both paradigms and addressing their individual shortcomings, fog computing fills the gap between Edge and cloud computing. Fog computing happens at the edge of smart end-devices at conventional cloud or data centres complimenting cloud computing. While cloud computing is important for storage of mass data, Edge computing happens at the edge of devices, as data are consumed and visualised by end consumers at the same time.

Fog computing research is still being conducted as Edge and fog computing are still fairly new and in development stages, with much support for both computing and simulation (Filelis-Papadopoulos et al., 2019). Organisations can utilise fog computing to use distributed computing power for real-time data analytics and processing tasks at the network edge, without placing excessive demands on the limited computational resources of edge devices. The efficiency, scalability, and speed of Edge computing applications, such as smart cities, industrial automation, and Internet of Things systems are all enhanced by this technique. Therefore, to establish a lasting foundation for the Internet of Things infrastructure in smart cities, both of these paradigms must collaborate (Perera et al., 2017).

Edge computing is the evolution of wireless sensor networks with far less limitation than legacy sensor nodes. With advances in smart materials and nanotechnology, which has led to the development of connected smart devices, such as smart glasses, smart watches, smart robots, smart meters; also connecting smart vehicles with smart mobile devices, have collectively been referred to as edge devices or the "edge" (Lopez et al., 2015). Large amounts of data are generated every month by smart devices at the edge", which have exceeded 14 exabytes and was expected to grow even further to 24.3 by 2019. Because of this, an increase in network traffic is being generated from these edge devices. Edge computing is a viable solution for smart metering where administering, processing and storage are close to the end users (Kumari et al., 2021). Sensor networks, Edge computing and the IoT ecosystems are main contributors that can either directly or indirectly make Society 5.0 a reality. Sensor networks, IoT ecosystem and edge devices are considered to be underlying the smart community concept (Olariu, 2020).

2.12 Smart cities

Smart cities rely on smart energy systems that integrate Information Technology with the local power supply systems. The main purpose of the smart energy systems is performed by smart grids, microgrids and smart houses. The application of microgrid and smart grid technologies has predominantly involved the construction of advanced energy management systems, known in Japan as Community Energy Management Systems (CEMs) (Hitachi-UTokyo Laboratory., 2020).

Smart cities are perceived to be ambitious projects that require extensive coordination and planning with various tasks carried out by the city administrators. The prime requirement in the digital era is to find ways to connect people with services and to ensure that they find an effective and effecient way to that ensure tasks are realistic in terms of service delivery. Several technologies such as IoT, AI, advanced networking facilities, for example 5G, and other Information Communication and Telecommunication support are fundamental in achieving smart cities (Zhou et al., 2020).

Smart cities are being developed globally to improve facilities and services within urban areas linking advanced metering infrastructure to ICT infrastructure. IoT technology, etc. are essential in this modern urban setup. To ensure energy efficiency, Narrow Band Internet of Things (NBIoT) is used as it is considered to be one of the most energy efficient and low resource-consuming versions of IoT available because it is easily deployable in considerably large areas. NBIoT also requires far fewerresources compared to other forms of IoT; hence it is regarded as one of the green technologies deployed for mass-scale digital transformation (Routray et al., 2021).

Smart cities encompass a wide range of services, systems and operations, each with specific objectives. Usually, these components are run independently by organisations like municipalities, utility companies, and transportation agencies.This independence may present opportunities and difficulties for improving overall efficiency and effectiveness in terms of coordination and integration (Atasoy et al., 2015).

2.13 Building energy management systems (BEMs) and Home energy management systems (HEMs)

Building energy management systems (BEMs) are a high-tech method used for controlling and monitoring building energy requirements (Hannan et al., 2018).

Home energy management systems are built to create smart homes with interaction between homeowners ("users") and home appliances, which are are designed to function by adjusting and performing tasks efficiently. These devices can be programmed interactively, whether directly or remotely. In order to make it smart, HEMs are supported by communication technology, programming language, sensors, controllers, and smart meters. Household electricity consumption is divided into planned and unplanned loads, utilising energy sources like power. Additionally energy storage units are linked to the grid, enhancing energy efficiency and supporting development goals by reducing carbon emissions and promoting friendliness (Hartono, Mursid & Prajogo, 2018).

2.14 Information Technology, Information Technology 2.0 and Internet of Things

With all being said, the IT integration with existing utility services is leading the way to a more advanced society. The idea that the progress of these communities, in tandem with advancements, is an important assumption in the concept of Society 5.0 (Deguchi & Kamimura, 2020). Web 2.0, also known as Information Technology 2.0, focuses on user content, making it easy to access. It creates a space that promotes interaction and online communication among users worldwide. Society 5.0 represents the merging of virtual and physical realms, while Web 2.0 is seen as a version that wholeheartedly embraces and enhances societal transformation (Nair, Tyagi & Sreenath, 2021). Information Communication and Technology (ICT) is the foundation on which these future innovative solutions are built.

2.15 Internet of Things devices

The Internet of Things (IoT) involves connecting objects and system components, with sensors, actuators and functions to communicate and offer services to consumers. The technology of IT and IoT has been used extensively in a variety of fields. Recently, production systems have started utilising IoT technologies, like radio frequency identification (RFID) wireless connections, mobile networks, cellular networks and sensor applications. The network of physical devices, such as buildings, objects, smart devices in homes, vehicles is called IoT (Sun, Yang & Xu, 2022).

IoT devices such as sensors, actuators, IoT gateways, or any device that connects the cycle of data collection, processing of the data, and transmission, are considered to be second components of the IoT platforms. These IoT devices allow routing the information into the IoT system, estabilishing bi-directional communications from the device to the gateway and from the gateway to the cloud. In the energy sector, IoT technologies have a wide range of uses, including managing transmission, distribution, and monitoring energy supply and demand. They can also be applied to raise the proportion of renewable energy, decrease the negative environmental effects of energy use, and promote energy efficiency. IoT technologies enable the use of cloud computing and various platforms for data analysis (Hossein Motlagh et al., 2020).The GSM Association has reported that by the year 2025 more than 25.2 billion IoT devices will be in use (Routray et al., 2021).

2.16 Smart meters

Essential components for both utilities and consumers are smart metering devices, which allow the correct transfer of meter readings, with correct time and date stamp, as they enable the remote measurement, monitoring and consumption of energy resources (Kumari et al., 2021).

Smart meters are used within a smart grid supply to do monitoring and measurement of consumption as well as to provide real-time communication of information between devices, enabling a greater level of control than would have been achieved by making use of conventional grids (Deguchi, A., & Kamimura, O., 2020).

Smart meters are essential to ensure grid communication between power producers, consumers and load aggregators; however, the most important features of the meter are the bi-directional energy and data flow features of smart grid technology. The incorporation of renewable energy resources with battery storage can decrease energy consumption and electricity prices drastically. (Rashid et al., 2021).

The utilisation of AMI (advanced metering infrastructure) and smart meters allows users to be cognisant of how they consume energy, to manage household appliances remotely, thereby reducing energy consumption during peak times and reducing electricity bills. Users have the ability to access information in real time, daily, weekly, or monthly since the smart technology allows the ability and capability to collect data, process data, prepare and represent data, enabling users to perform energy management (Hartono et al., 2018).

Some meters connect wirelessly: IoT is activated through wireless communication systems, connecting sensors and devices to IoT gateways, allowing communication between these components of IoT (Hossein Motlagh et al., 2020). These smart meters, as previously mentioned, record electricity generation and consumption of data. This data is then delivered to an oracle that manages the movement of information between the real-world and blockchain (Murkin et al., 2016).

2.17 What type of skills would the workforce require for a private utility to support a super smart society?

The fourth industrial revolution (4IR) serves as the basis for new value creation and innovation, opening doors for the dawn of an era of innovation economies where professional attitudes and knowledge development regarding work are combined with the acquisition and advancement of ICT to realise a means of fostering creativity and innovative processes that boost productivity and efficiency in the workplace. The speed at which new and smart technologies are being deployed in the business and private environment requires businesses to invest in their employees to attain new competencies and skills, also creating new knowledge and sharing of knowledge, which necessitates that individuals have access to internet-connected gadgets (Roblek et al., 2020).

One of the 12 job drivers that was expected to generate an extra 5 million jobs by 2020 is the green economy (Ratshomo & Nembahe, 2021). From establishing strategic goals and objectives with comprehensive plans and programmes to accomplishing digital transformation, which the energy sector is responsible for implementing, managers and staff must have a thorough awareness of what the digitalisation process comprises.

It is therefore extremely important to keep employees involved, to get their opinions and ideas about transformation benefits perceived by them in the digitalisation of the sector, and also to get an understanding of what difficulties they may be facing in the process (Światowiec-Szczepańska & Stępień, 2022).

Industry and society are brought together by Industry 5.0, where advanced technologies are constantly used in society's everyday life. Industry 5.0 puts a premium on the development of resources, production worker functions, and new occupations as skills continue to evolve. The cyber-physical world requires the continuous and ongoing digitalisation of new skills from both users and designers. Companies have to start preparing and adapting quickly, more so owing to the changes in the qualifications and skills of employees (Saniuk et al., 2022).

Blockchain technology applications in the energy sector have emerged as a fascinating field for study and research with a lot of room for creativity. With the continuous expansion and progression of data and distributed systems within the energy sector, centralised approaches are deemed inefficient, with this data management, enhanced digital infrastructure, and reliable information (Ahl et al., 2020). Since blockchain technology is still very new, few people have the expertise in blockchain development and implementation in industrial automation. Organisations need highly qualified and experienced personnel if they are to fully utilise blockchain technology. These resources must be skilled in how to perform real-time deployment in industrial automation and therefore, hands-on practical training would be required (Tanwar et al., 2022).

Existing workforce roles are rarely mentioned and therefore various scientific studies have highlighted the need to include human role assumptions as part of future industrial development. 5IR implies the increased collaboration between humans and intelligent production systems, combining the best of both worlds, with accuracy and speed guaranteed by automation and digitalisation and the capabilities of the human brain in terms of cognitive skills and creative thinking (Saniuk et al., 2022). Furthermore, steps should be taken to build on the lack of in-depth technical knowledge, capabilities and skills in Big Data analytics, predictive analytics, and security analytics to address the potential risks of access management, fraud prevention, governance and compliance (Kabanda, 2021). Critical thinking, interpretation and analysing Big Data are perceived to be huge advantages as they assist with new business creation for the organisation, and having these skills assist the employees in performing their job optimally (Wang et al., 2018). It is also important for management to develop their capabilities such as in combining technological, strategic, and functional skills that are not easily replicable (Shamim et al., 2019). It would be worthwhile to explore the phenomenon empirically to provide guidelines on what is required by private utilities to operate in a smart community within Society 5.0.

2.18 Conceptual framework

Figure 2.1 presents a conceptualisation of the problem as seen through the lens of the gaps in the selected and relevant reviewed literature. The literature review directs the gathering of data and serves as the basis for discussing the findings derived from the empirical data. The diagram depicts the potential digital infrastructure required for a power utility within a smart society environment using renewable energy and, in some instances, a combination of both electrical and renewable energy in smart grids, which would enable utilities to switch between traditional electricity and renewable energy, helping with grid stability and the ability to manage supply and demand better.

A cloud-based network called virtual power plants (VPP) connects and controls distributed energy resources (DERs), such as solar and battery-powered smart homes and commercial buildings, into a single power plant for more environmentally friendly energy management. Smart grids use microgrids to supply energy to smaller communities while they are still connected to a bigger network. Microgrids, on the other hand, allow communities to be connected to a smart grid using inverters that can either be connected or disconnected from the smart grid and operating in Island mode,or in isolation.

Super smart societies are merging cyberspace and physical space to facilitate the collection of real-world data using digital technology through digital communication (IoT) and utilising AI to analyse the vast amount of data obtained. Big Data gathered by smart devices, such as smart metering units, sensors, etc., is stored in the cloud via cloud computing, and artificial intelligence (AI) tools like machine learning are utilised to perform advanced analytics that facilitate user convenience and decision-making.

Although 4IR technologies like AI, Blockchain, Cloud, Fog, and Edge computing are used in Society 5.0. It is yet unclear what particular capabilities a utility needs to operate in this context. It is therefore necessary to assess the feasibility of the proposed structure and the requisite workforce skills to support, maintain and sustain such an environment fully.

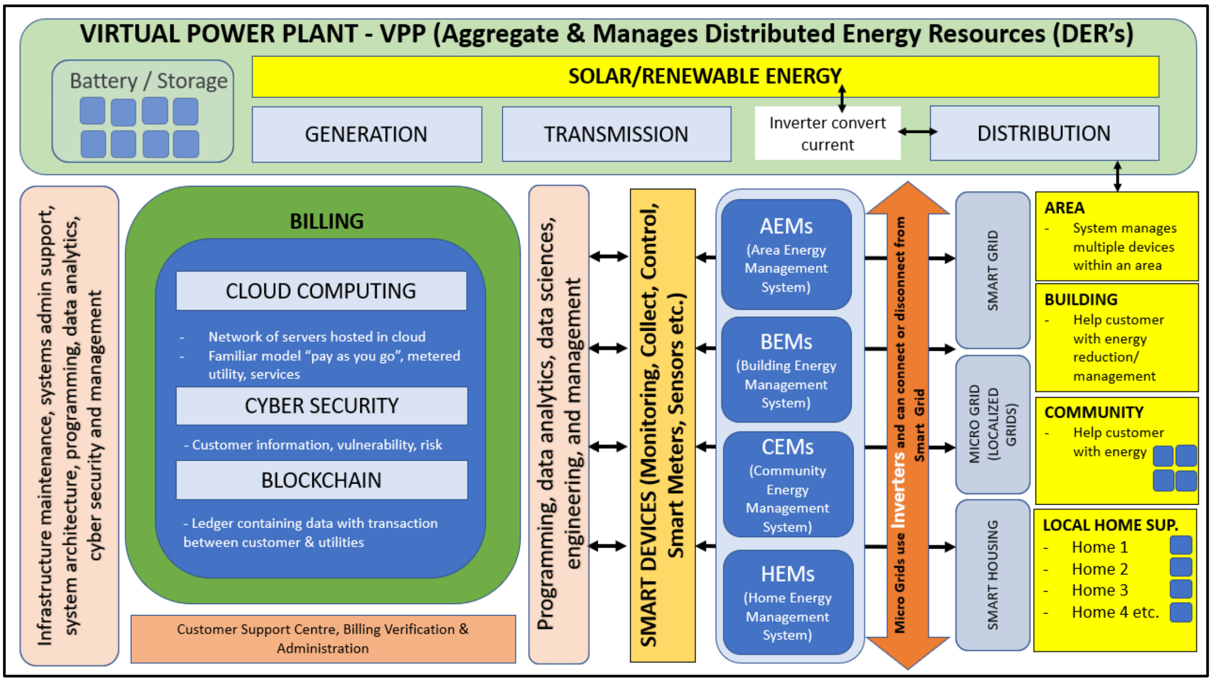

Figure 2.1:Summary of the chapter

The concepts and keywords used in the literature review were derived from the research title, problem statement, research questions and objectives. This chapter included a thorough analysis of the body of knowledge relevant to this research project. The research approach that was employed to accomplish the research goal is highlighted in the next chapter.

CHAPTER THREE:

RESEARCH APPROACH AND METHODOLOGY

3.1 Introduction

The preceding chapter included a thorough analysis of the literature supporting the creation of a conceptual framework that aided in the gathering of data and the assessment of empirical findings. In this chapter philosophical assumptions underpinning the study and information, such as the research design and empirical techniques applicable to the study will be discussed. The pandemic and the “buzzword” fourth industrial revolution, sparked the interest to envisage what a future private utility organisation would look like with the advanced technologies brought on by 4IR.

The current power supply problems in South Africa make it necessary to explore alternatives such as renewable energy supply and consumption strategies. To stay ahead of the curve and be able to survive in the energy business, private utilities are getting ready for the digital transformation. Within the South African private utility industry organisations use some 4IR technologies. However, this study aimed to explore what digital infrastructure and capabilities are required for a private utility to benefit fully from Society 5.0. The discussion of the researcher‘s epistemological stance in relation to the accomplishment of the research objectives, methodology, research approach, research strategy/design, and supporting research methods that were chosen to address the research questions will be covered in the sections that follow. These include:

3.1.1. What digital infrastructure is required for a private utility to benefit fully from Society 5.0?
3.1.2. What types of skill would the workforce require for a private utility to support a super smart society?
3.1.3. How can private utility organisations assess their readiness for Society 5.0 innovation?

3.2 Research paradigm

The aim of this study was to investigate the digital competencies needed by the private utility sector to be competitive and to engage in Society 5.0. The intent was to explore and access perceptions and implications within the private utility environment and the impact it would have. This research utilises an interpretivist paradigm to explore the digital skills required for private utility organizations to succeed in Society 5.0. By employing this methodology, the study focuses on the personal viewpoints and experiences of individuals working for an organisation operating within the private utility industry.

A theoretical framework, often known as a paradigm, shapes how knowledge is understood and investigated. There are various research paradigms that can be applied, namely positivist/postpositivist, interpretivism/constructivist, transformative and pragmatic (Alharahsheh & Pius, 2020). With the interpretivist/constructivist paradigm, the intent was to understand and experience the world from a human perspective, thereby enabling an in-depth understanding by asking *what, why, and how* questions about a particular phenomenon to understand and explore issues of influence (Deetz, 1996; Mackenzie & Knipe, 2006); thus aligning suitably to the objectives of this research.

This study used an interpretive paradigm, meaning that the design of the data collection process was informed by theory using the conceptual framework (problem conceptualisation) developed based on an initial observation of the phenomenon using the literature (Mertens, 2009; Walsham, 1995). Researchers can obtain a deeper knowledge by looking for perspectives and experiences of a certain social setting using an interpretivist paradigm (Alharahsheh & Pius, 2019). According to interpretivism, people create knowledge to make sense of the world around them and the experiences they have in it. From the interpretive perspective, the perception is that all knowledge stems from our specific experiences; that is, subjective and bound to the natural contexts in which we engage our lives (Hiller, 2010). The selection of an interpretive framework allows for a detailed investigation into the impact of digital transformation on private utilities. This method emphasizes the comprehension of participants' perspectives through qualitative approaches, which is in line with the study's goal of identifying the specific infrastructure requirements and workforce competencies necessary for adapting to the digital environment. Data collection was guided by a conceptual framework that emerged from the literature, allowing the research to align theoretical perspectives with real-world experiences. This informed the development of interview questions aimed at eliciting detailed responses about the competencies and capabilities required for successful digital integration.

The ontological viewpoint acknowledges the possibility of many realities while reflecting the perspectives of lived experience, cultural influence, and meaning. This paradigm emphasises the possibility of “multiple realities”, which are explained from the emic standpoint of the “lived experience”. German intellectual traditions of both “Hermenuetics” (interpretation) and “*Verstehen*” (understanding) have been recognised as important influences in the development of the interpretivist paradigm, giving clues to the complexity and various types of methodologies that can all be underpinned under the heading of “interpretivism” (Kelly, Dowling & Millar, 2018). The interpretive paradigm provides a better understanding of what the implication would be from an organisational and individual perspective, considering future changes within the utility environment. A case study approach was helpful for this investigation since it sought to address *how* and *why* questions. This methodology is also quite appropriate for the field of operational management research.

3.3 Research approach

Research approaches can be classified broadly into two categories: quantitative and qualitative. While quantitative research is undrtaken through statistical testing, and findings are presented in numerical form, aligning to a positivist research paradigm, qualitative research is particularly useful for underexplored phenomena and is particularly associated with an interpretive research philosophy that employs a naturalist approach in the study of a phenomenon (Domegan & Fleming, 2007).

The qualitative research approach observes and collects information, keep notes, describes and interprets events/ experiences in their truest form. The main benefit of qualitative research is the opportunity to deepen research (Basias & Pollalis, 2018). A qualitative technique would be a suitable means of achieving the study objectives, given the subjective nature of the research questions and the underexplored area of focus.

The study conducted an investigation by means of participant observations and interviews conducted using a qualitative research approach. The assumption is that the outcome of the interviews is a true representation and the perspective of the participants involved (Teherani et al., 2015). Given the nature of the phemenon and the type of business, qualitative research was most suitable as it did help the participants to express themselves and also to understand what human interventions are involved when performing tasks, expressing their personal and lived experiences, observing verbal and non-verbal communication. Qualitative research is often said to employ inductive thinking owing to the fact that it moves from specific observations from an individual's perspective to larger generalisations and theories.

It requires the researcher to spend an extensive time doing fieldwork, such as complex, time-consuming processes of the analysis of data, typing out long passages, and taking part in a form of social and human research without guidelines or specific procedures (Soiferman, 2010). On the other hand, in-depth knowledge of social situations, human behaviour, and complicated phenomena is made possible by the many advantages that qualitative research provides. Key benefits of qualitative research include richness and depth, enabling researchers to uncover rich and detailed insights into individual experiences, perspectives, and motivations. Flexibility and adaptability allow the researcher to adapt and adjust their approach to findings and unforeseen developments. Qualitative research, in general, offers several benefits that aid in a thorough understanding of phenomena, addressing the nuances and subtleties inherent in social interactions, cultural contexts, and human behaviour (Lunnay, Foley & Ward, 2023).

3.4 Inductive approach

The 1960s saw a rise in the importance and development of the inductive data analysis methodology, especially in the social sciences like anthropology (Tavory & Timmermans, 2014). This occurred as a result of the shortcomings in the more conventional deductive approach, which was always dependent on theoretical frameworks and preset hypotheses (Haque, 2022.). The social sciences, in particular disciplines like sociology, anthropology, and qualitative research in general, use the inductive research methodology (Gadwal, 2022). Using an inductive research technique, new theories are created based on the information gathered.

Inductive research begins with observations and patterns in data and then develops general principles or hypotheses based on those observations, in contrast to deductive research, which begins with a hypothesis and then aims to verify it through data collecting and analysis. It is employed in research questions to focus the study objectives and is generally associated with a qualitative approach with the aim to develop a new theory. The approach of induction involves starting from specific observations and then drawing broad generalisations. (Han et al., 2024).

Figure 3.1: Inductive research approach

The inductive method is highly beneficial for exploratory research, particularly when examining unfamiliar phenomena for which current theories may be inadequate. This approach enables researchers to develop theories based on empirical evidence, potentially resulting in relatively new discoveries and understandings (Brobbin et al., 2024).

3.5 Deductive approach

The deductive method of reasoning and research entails deriving particular conclusions from general principles or theories. Starting with the general and moving towards the specific, it involves formulating hypotheses based on existing theories or principles, and then testing them against empirical evidence. In deductive reasoning, if the premises (generic principles or theories) are accurate and the logical process is valid, the conclusions formed from them are considered reliable. This approach is commonly associated with quantitative research and is typically designed to test theories, generally starting with a hypothesis. The deductive method seeks to verify an established theory. Deductive reasoning starts with principles or guidelines, then applying them to particular cases or outcomes, whereas inductive reasoning begins with a specific observation and then draws broader conclusions or theories (Kumar & Ujire, 2024).

When conducting hypothesis-testing research, scientists frequently employ the deductive method to support or contradict pre-existing theories or hypotheses. Its broad application of statistical analysis and organised techniques for gathering data frequently links it to quantitative research methodologies. One of the prime features of the deductive method is a systematic and structured methodology that enables rigorous testing of theories and hypotheses. It also offers precise standards for assessing the viability of theories and producing factual data to either confirm or refute them (Fife & Gossner, 2024). Nevertheless, there are drawbacks to the deductive approach as well, such as the possibility of missing unexpected or unanticipated results that do not conform to the predefined theoretical framework.

A deductive qualitative approach is qualitative research that combines deductive reasoning with qualitative data analysis techniques. While deductive qualitative research begins with pre-existing beliefs or notions and then uses qualitative data to evaluate or develop these theories, inductive reasoning – where theories or hypotheses emerge from the data – has historically been the focus of qualitative research. By asking questions that are challenging to answer with data, qualitative research helps one to gain a deeper understanding of human experience. Addressing significant issues entails evaluating the useful components of many social phenomena and acquiring an understanding of their routine behaviours (Charmaz & Belgrave, 2012). During the interviewing process, the interviewer mat pick up “gems” that might not typically have been found otherwise, such as in completing online surveys.

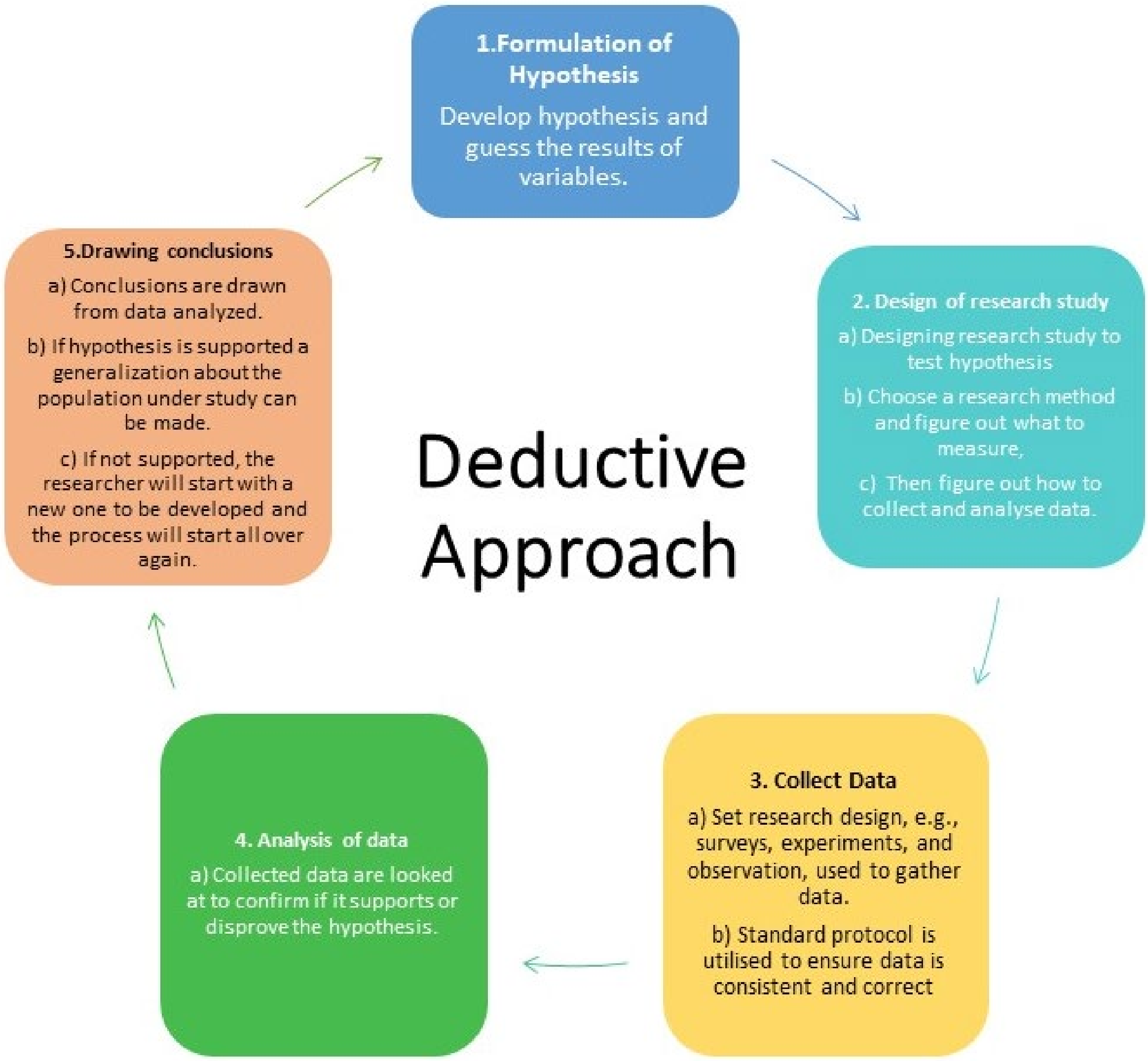

Figure 3.2: Deductive research approach

With a purely inductive approach, researchers begin with raw data and seek to extract variables, themes, or patterns directly from the data without being influenced by any predetermined theoretical framework or hypotheses. This method focuses on allowing the data to speak for itself, enabling themes and patterns to emerge naturally through analysis. The researcher avoids imposing any preconceived concepts or theories onto the data.

With a combination of inductive and deductive approaches, an approach that integrates both inductive and deductive elements entails extracting variables or themes from the data while also being directed by a conceptual framework or theoretical perspective. The data are the main source for identifying patterns or themes, but the researcher can also use existing theories or concepts to guide the analysis process. This could involve using a theoretical lens to interpret the data or to guide the initial stages of data coding and analysis. The researcher is willing to consider new insights that may challenge or refine the initial theoretical framework while remaining open to allowing new insights to emerge from the data. For this study, a combination of inductive and deductive approaches was utilised, through which the derivation of variables using the blended approach was based on the raw data (an inductive process), and the analysis was informed by a conceptual framework or theoretical perspective (a deductive process) (Proudfoot, 2023).

Interpretive scholars hold that social constructs like language, consciousness, and so on are the only ways in which reality – whether socially constructed or intrinsic – can be ascertained as well as shared meanings, and tools (Myers, 2019). Probing participant responses can provide valuable context to enhance the depth of the data. This approach allows for a more thorough understanding of participant views, replies and their significance. As a result, the importance of the data is enhanced by the added context (Saunders, Lewis & Thornhill, 2003).

In qualitative research, “interpretive” refers to a method or point of view that focuses on understanding and elucidating the subjective meaning and experiences of individuals or groups in their social and cultural contexts. The goal of interpretive research is to make visible the underlying meanings, symbols, and viewpoints that shape social phenomena, human behaviour, and interactions. As was already said, this research was carried out in an interpretive manner since it offers a “holistic” perspective of the processes involved and a realisation of the research issue. An interpretive qualitative research method could be a suitable way to investigate and assess the current research field in the crucial area of study that is the strategic management of digital systems.

Explaining, finding, exploring, understanding, and clarifying emotions, situations, perceptions, values, beliefs, attitudes, and experiences is the primary driving force behind qualitative research (Basias & Pollalis,. 2018). For the purposes of this research, it is critical to comprehend and investigate the digital competencies needed by the private utility sector in order to engage with and maintain competitiveness in Society 5.0.

3.6 Research design

The rationale behind research design links the goals and research questions to the procedures for gathering and analysing empirical data so that conclusions can be drawn from it. (Bryman, 2012). New qualitative researchers who work in the field where some understanding has already been achieved, stress the importance of “prestructured research”. Having said that, the researcher should make an effort to avoid bringing any assumptions from the literature review into the field. It is advised that no specific theories or propositions be developed before meeting with the interviewees (Ponelis, 2015). When designing the questions, clear objectives must be set so that when the data are collected, the research questions are answered.

Exploratory research generates new empirical data, thereby increasing knowledge and understanding of the phenomenon (Burns & Grove, 2001), thus suitably aligning to the fact that is an underexplored area of focus. This research may be regarded as an empirical study. The definition of empirical research is that it is a planned process of data collection, through an individual's personal experience in a certain environment. An empirical study gives the researcher the chance to learn about an event by examining the participant‘s experiences. (Neuman, 2014).

3.7 Overview of case study

The research topic is entitled: *Exploring the digital capabilities of private utilities for Society 5.0.* It is envisaged that this research will help to develop a model/ framework that can be used to guide the implementation of 4IR technologies within Society 5.0. The study will benefit organisations within the private utility sector that are gearing themselves up for Society 5.0 by providing guidelines on what is required to operate in a smart community within Society 5.0. The organisation selected for the study operates within the public and private utility sectors. With alternative renewable energy becoming more prevalent within the private utility sector it is important that organisations and their resources are ready to be able to support these new technologies brought on by 4IR Technologies and be able to support a Super Smart Society.

3.7.1 Background

The organisation that was researched is in the Western Cape. The organistion was selected owing to its operating within the private and public utility space and because of its use of advanced smart solutions and technologies for its water, electricity, gas, and solar projects. The chosen firm is a pioneer in smart technology and is committed to providing cutting-edge solutions to South Africa‘s gas, water, and power industries. They create metering methods and systems that satisfy the demands of end users, private sector businesses, municipal settings, and big utilities.

The organisation's customer base and operation reaches across all provinces within the Western Cape with some customer outside of South African borders. The company has developed systems and metering technologies over the past 30 years in close collaboration with its clients to satisfy the demands of major utilities, local governments, and private businesses. Products and services are well known in the field, and the company is regarded for providing exceptional quality and customer service in addition to providing top-notch revenue-to-meter solutions.

3.7.2 Population

Usually, the target or focus group specified is the research population, on which the research is based. The population group‘s inclusion or exclusion from the study must be made clear up front. (Banerjee & Chaudhury, 2010). It is crucial to concentrate on a certain target demographic in order to ensure that the study is directed towards that group. Data that are representative of the target population are then gathered through sampling (Stratton, 2021). In a research study, the population is all the people, things or events that the researcher is interested in examining and from whom a sample is taken. It acts as the more general category under which the study findings are intended to fall (Malthus, 2023.). The population for this study constituted a selection of permanent and contract employees who had to have worked in the organisation for at least three months or more.

The respondents should also have relevant work experience within their position or prior work experience within the private utility environment. All employees working in the Management Team, IT, Customer Solutions Centre, Solutions Technical Centre, Finance Department, Project Office, and Operational Support alone made up the study population. These staff would align suitably to contribute to the theoretical stance of this study, as guided by their relevance to the problem conceptualisation.

3.7.3 Demarcation/delimitation of study

According to Teherani et al. (2015), the delimitations are qualities that outline the parameters of the study problem and restrict its scope. These boundaries are set by the researcher to ensure that the research aim and objectives do not become unattainable (Theofanidis & Fountouki, 2018). The studywais therefore limited to focusing on a private utility organisation and its employees based in Cape Town, Western Cape, and only focused on answering the research questions to achieve the objectives of the study.

3.7.4 Sampling

Sampling constitutes the process for selecting the respondents, and is extremely important for the study. The population, according to Welman, Kruger and Mitchell (2005), is a set of possible responders from whom one wishes to extrapolate the study findings. Only once the results are mapped or plotted from a sample would the study be meaningful. The sample is therefore identified as the population from which it was nominated. There are probability and non-probability sampling techniques (Shukla, 2020).

According to probability sampling, any item or population member could be included in the research, whereas, non-probability sampling is more often used owing to its convenience, and is more suitable for qualitative research because of the respondent's position to be able to contribute to the theoretical stance of the study. Motivated by the problem conceptualisation and the objective of acquiring rich data, the researcher's judgement was utilised to select the target group and sample for the study, given the understudied topic of the research (Bernard, 2002).

Table 3.1: Summary of the participants demographics

Participants	Job title	Age group	Years of experience
1	Service Centre Agent	26–35	7y
2	Technical Support	26–35	7
3	Technical Support	26–35	1
4	Field Technician	26–35	
5	Private Utility Operator	26–35	1
6	Smart Metering Specialist	46–55	more than 10
7	Service Support Technician	26–35	9
8	Operations Coordinator	36–45	18
9	Business Development Manager	36–45	2
10	Technical Key Account Manager	26 – 35	More than 5 years
11	Business Development Manager	36–45	more than 5
12	Sales Representative	36–45	15
13	Business Development Manager	46–55	22
14	Business Development Manager	36–45	14–15
15	Operations Manager	Over 56	14
16	Smart Technical Centre Manager	36–45	12

Quota sampling involves collecting respondent data from a group. This technique guarantees that the group designated as a sample represents particular attributes of the population that the researcher has chosen (Yang & Banamah, 2014). There are two types of quota sampling: uncontrolled quota sampling, in which the researcher is allowed to choose participants based on their preferences, and controlled quota sampling, in which specific limitations are imposed to restrict the selection of samples.

Snowball sampling is defined as follows: a small group of participants who meet the suggested criteria are contacted and requested to join in the study. They are then asked to recommend and advise further contacts or participants who meet the established criteria. In this sampling technique researchers will use their social network to find links, and momentum is created from there. With this technique sampling will stop once the target objective is achieved or to the point of saturation. The criticism and limitation of this techique as that its viewed negatively as it does not typically produce sampling that meets the criteria of random sampling in the statistical sense. Snowballing is therefore frequently used by qualitative social researchers, such as people who describe and study cultures within a specific group (Parker, Scott & Geddes, 2019).

Purposeful sampling, sometimes called judgemental or selective sampling in qualitative research, is a non-probability sampling technique that chooses cases or participants according to particular standards relevant to the objectives of the study (Fuentes, 2024). Purposive sampling has many shared views that it is straightforward and easy. This is because sampling will be more robust, the information gathered will be more reliable, and the results will be more accurate if it is well matched to the goals and objectives of the research (Campbell et al., 2020).

Owing to the qualitative approach selected, non-probability sampling was used for this research. This study specifically used purposive sampling, a non-probability sampling strategy that is frequently used in qualitative research (Etikan, Musa & Alkassim, 2016) . Purposive sampling was the preferred method selected as it was considered to be more effective. This technique allowed for the proper selection and identification of the respondents as well as the sites that could firmly inform an understanding of the research problem. When using purposeful samples for non-probabilistic sampling, the size of the sample is usually dependent upon saturation or the point at which no new themes or data can be seen from the collected data (Guest, Bune, & Johnson, 2005).

During the selection of the sample group and size, the researcher had to be cognisant of the following considerations (Welman et al., 2005).

- The size of the population was carefully fixed so that it would be sufficient to draw reliable, valid and generaliseable conclusions.
- Sample size required specific information from the problem being researched in the population being studied.
- Strata of population could vary in divergency and size.
- The total number of respondents that would be required for the study from which usable information received could be fewer than the number initially selected.

The focus of the study was limited to a private utility organisation with Cape Town based offices. The sample size at the start of the research consisted of about 18 employees, from various regions, namely Secunda in the Mpumalanga region, Johannesburg in the Gauteng region and the majority based in the Western Cape. The population comprised Engineering support and Administration, Engineering Specialist, Business Development, Sales, Technical support teams, including middle- and senior-management representatives.

The selected group of participants was identified owing to their experience within the specific field and industry that formed part of the study. These representatives were operationally functional within the various selected departments and had the necessary experience to be able to participate and provide insight that would potentially benefit the study. Saturation point refers to the moment in research when collecting more data – especially when using qualitative research techniques like observations or interviews – no longer provides fresh information or insights into the topic of the study (Daher, 2023). The saturation point was reached with 16 participants, since gathering further data beyond this number was unlikely to yield new insights and perspectives.

3.8 Inclusion and exclusion criteria

The selection of participants with specific traits or qualities that are relevant to the research topic is done in qualitative research by applying inclusion and exclusion criteria. Qualitative research frequently centres on comprehending subjective experiences and viewpoints; however, researchers must still confirm that participants are appropriate for addressing the research questions and goals (Meline, 2006).

3.9 Recruitment of research respondents

Before setting up the interviews, the prerequisites for participation in the study, including demographics, clinical or diagnostic standards, inclusion and exclusion criteria, and any other relevant eligibility requirements were clearly stated (In, 2017). Finding and enrolling individuals who are willing to engage in the study and who meet the eligibility requirements is known as recruitment in research studies. Effective recruiting is crucial to obtaining a representative sample and ensuring the validity and generalisability of the study findings (Frank et al., 2024).

3.10 Data collection instruments

Then there is the collection of primary and secondary data. The process of collecting information using various interview and observation techniques is known as primary data collection, while data from an earlier study is known as secondary data (Saunders et al., 2003). In order to guarantee that a thorough overview of the literature was supplied on the matter and to give a general awareness of current concerns surrounding the basic research theme, secondary information was used, such as journals, articles, books, and dissertations on prior studies.

There are various instruments that can be used to gather empirical data, such as questionnaires, case studies, interviews, focus groups and observations (Daniel, 2016). Selecting a tool for gathering data is critical as it should assist with collecting information to support or be able to answer the research questions (Canals, 2017). Given their ability to provide insights into understudied phenomena, interviews are considered one of the most significant tools for gathering qualitative data (Qu & Dumay, 2011).

Prepopulated interview questions were used as a guide for semi-structured interviews that were used to gather data for in-depth one-on-one interviews. (Canals, 2017). The interview questions were developed through the lens of the problem conceptualisation framework which formed part of the study. Therefore, there is structure in relation to the themes that guided the development of the questions, but the questions were still largely open-ended to allow for the collection of in-depth views on the phenomenon.

3.11 Design of the interview schedule

The researcher employed semi-structured interviews as a type of qualitative research technique to obtain comprehensive data from participants. Semi-structured interviews provide a more flexible framework as opposed to structured interviews, which adhere to a preset list of questions asked in a standardised manner. This approach allows for a combination of predetermined questions and the opportunity to explore additional topics based on participants' responses. Interviews were scheduled in advance with face-to-face interviews held in meeting rooms for participants based in Cape Town. Interviews with staff members outside of the Western Cape were conducted via Zoom and Microsoft Teams. All interviews started by providing the interviewees with a copy of the consent form and interview guide which participants were required to sign to give their approval. Interviews were scheduled for 60 minutes per participant.

Interview questions were developed in accordance with the research questions developed for the study. The questions were divided into two sections, namely section A, which covered the basic participant information, and section B, which was designed more specifically for the various departments the participants were representing.

3.12 Pilot study

A pilot study is a small-scale exploratory investigation carried out before the main research project with the aim of evaluating and optimising research methodologies, procedures, and instruments (In, 2017). The main goal of a pilot study is to find and fix any potential problems, restrictions, or difficulties that might come up during the main research project, therefore enhancing the study's validity and quality.

A way to test the quality of the envisaged interview procedure and identifying possible biases is to employ a pilot study by which the investigator will try out the method to practise the planned procedures for conducting the interview (Hazzi & Maldaon, 2015). Testing the interview methods beforehand could help to enhance them in a pilot study. This procedure might highlight any shortcomings or restrictions in the interview design, allowing for necessary adjustments to be made prior to the primary research study (Majid et al., 2017). The process was also utilised to estimate the time needed to finish the interview.

3.13 Recruitment of participants

Prior to the interview session, interviewees were contacted to request permission to book an appointment at their earliest convenience. Interview invitation requests were sent via email and booked in calendars. Based on acceptance of the invitation sent, interviews were conducted accordingly. The time slots per interviewee were booked for 60 minutes. The researcher gave a brief introduction on the day of the interview, outlining the background of the study and introducing herself. Interviewees were informed that the sessions would be recorded either using a smartphone or Teams recording. Their information would not be shared or used in any other way outside of the scope of study and ethical considerations granted.

3.14 Data collection/fieldwork

The best things about the case study approach are its adaptability and flexibility, which allow one to employ one or more data collection strategies to investigate the research subject properly.

Since it can improve the depth and calibre of a social research study, data collecting and the application of a data gathering method are crucial (Rimando et al., 2015). Therefore, based on the strategically selected sample, key strategic stakeholders from the organisation were consulted via email to confirm their participation as part of the study.

The interview guide was submitted for ethical clearance for approval and consent was obtained from the organisation under study before participants were approached to participate in the study. Interviews was booked timeously with a limited timeframe of 60 minutes per session. One-on-one interviews were conducted with staff constituting the sample. The researcher therefore became the data collection instrument which was crucial for understanding the causes of certain events, using techniques such as probing and follow-up questions (Teherani et al., 2015). After being recorded, the interviews were transcribed so that they could be analysed.

The handling of the gathered data was one of the special difficulties with the multi-case study. It was important for the researcher to find ways to manage the information collected from interviews without being overwhelmed. It is imperative to maintain a full and methodical record of the data gathered, both for analytical purposes and for future reference (Ponelis, 2015).

3.15 Constraints and limitations

A private utility organisation was identified for the study and therefore one of the limitations was that only employees of the organisation could participate.

3.16 Reliability and validity

Two essential research methodological concepts that are used to assess the calibre and dependability of study findings are validity and reliability (Sürücü & Maslakçi, 2020). The consistency, stability, or repeatability of research findings is what reliability refers to. It illustrates the degree to which a study's findings can be repeated or replicated in comparable circumstances (Mulugeta et al., 2018).

3.17 Ethical considerations

Ethical considerations and principles should always be applied and adhered to. Before the data gathering process began, the company and its personnel gave their approval and written authorisation, since it would have been challenging to acquire consent after (Fleming & Zegwaard, 2018). Furthermore, ethical clearance and permission to conduct the study were obtained from the Higher Degree Committee at the Cape Peninsula University of Technology, Distict Six campus. All protocols related to the interview were explained to the interviewees on the day of the interview. Interviewees received assurance that any information they revealed for the purpose of the study and during the interview would be kept private and not shared with third parties.

Ethical considerations were discussed and presented during the interviews to ensure confidentiality, reliability and the backing of the institution solely for the purpose of the study conducted. Owing to the nature of the business, most of the interviews were scheduled via Teams for interviewees not based at the Head Office. The interviewees who were office based were invited via invitation using Microsoft Calendar and face-to-face interviews took place in either the board room, meeting rooms or conference room, whichever were available at the time. Interviewees were informed that the set interviews would be conducted in English.

The interviewer discussed the content of the questionnaire and briefed the participants about the interview process. The participants were reassured that they could leave the study at any moment, that the material presented in the interview is private, that their identity would be protected, and that the interviewees' personal information Would not be shared (Åkerfeldt & Boistrup, 2021). The interviewer requested permission from participants before audio-recording the interviews. Any recordings and transcripts of interviewee information would be stored securely with access only available to the research supervisor and the researcher conducting the study.

The participants were further reassured that the findings from the interviews would be presented in such a way that readers would not be able to link the participants' given responses to the participants' identity (Wiles, Kulesus & Mulvey, 2008). In order to maintain anonymity, the chapter on data analysis refers to respondents as "Participant 1" rather than by their actual names when citing their answers. The research survey was reviewed meticulously to prevent the inclusion of questions that could raise emotional or psychological concerns for the participants (Vanclay, Baines & Taylor, 2013). The data collection from the interviews remained unbiased and, as a result, was not manipulated to match the researchers' perspectives.

3.18 Chapter Summary

Chapter Three addressed research methodology, which includes data collection, data analysis, research philosophy and research approach. The problem was restated, the study's objectives were outlined, and the research questions were presented at the start of the chapter.

The research philosophy informed the themes of ontology and epistemology in this chapter. Since there are multiple perspectives on the phenomenon under investigation, an interpretivist epistemology was used in this study. In addition, a subjective ontological stance was selected because each participant had a unique perspective on the phenomenon under investigation.

CHAPTER FOUR:

FINDINGS AND INTERPRETATIONS

4.1 Introduction

In Chapter Three, the research methodology was discussed in depth with the research approach applied in this qualitative research. Chapter Two presented contextual information important to underpin the study. The goal of this chapter is to provide and go over the analysis and findings of the interviews that were undertaken for this qualitative study.

The findings from the participants that were selected to take part in the study – administrative, operations, technical teams, engineering, and management – will be interpreted in this chapter (align resources identified with the research methodology section). The findings from the interviews with private utility employees at a particular organisation in South Africa's Western Province will also be discussed.

4.2 Research questions

4.2.1 Main research question:

What are the digital capabilities of a South African private utility to participate and compete in Society 5.0?

4.2.2. Research sub-questions

4.2.2.1 What digital infrastructure is required for a private utility to benefit fully from Society 5.0?

4.2.2.2 What type of skills would the workforce require for a private utility to support a Super Smart Society?

4.2.2.3 How can private utility organisations assess their readiness for Society 5.0 innovation?

4.3 Aim and objectives of the study

4.3.1 The main objective of this study

To explore the digital capabilities required by the private utility environment to participate and remain competitive within Society 5.0.

4.4 Overview of analysis

4.4.1. Introduction

This chapter presents the main ideas and takeaways from the interviews conducted for the study, in addition to the research questions and goals listed in Chapter Three. Management and technical staff responsible for managing and coordinating the activities of utilities and the technical staff responsible for the implementation and maintenance of energy solutions, in a utility company were interviewed to establish and ascertain their digital capabilities and preparedness for the fourth and fifth industrial revolutions (Society 5.0). A total of 15 interviews were conducted featuring managerial-level staff and technical staff.

4.4.2 Process of qualitative analysis

A thematic analysis was performed on the information gathered from the semi-structured interviews. Segmenting, classifying, summarising, and rebuilding the qualitative data set in a way that captured the central idea was part of the data reduction and analysis approach.

4.4.3 Description of the interviews

A non-probability sampling strategy called purposive sampling was utilised in this study because the researcher was unable to access the entire interest set. Fifteen semi-structured interviews were performed, with the participants featuring a private utility company's management, administrative, and technical staff, as shown in Table 4.1. All interviews conducted were recorded after obtaining consent from the participants. Probing questions were asked until the participants supplied the information needed to address the study questions.

4.5 Demography

The management of a Society 5.0 digital private utility require the activities of established experienced intellectuals. The efforts of these individuals who are responsible and can collaborate well with others is required to use 4IR resources sustainably. This is in the view of participants TV, TM, PS, NtsM, FinC, GP and BW. The handling of Society 5.0 digital utilities requires experience.

The length of time spent managing a digital private utility is related to efficiency and/or job performance. This is in support of the view of TM, which is synonymous with the number of years in the current department. TV, BW, GP, YS, FinC, and PS who have spent more than seven years in their current position have more experience in digital private utilities than TM and NtsM who are in their early years.

It is obvious from the data collected that more male than female gender are working for this selected organisation; three females and 12 males were interviewed.

Table 4.5.1: Participant summary

Respondent	Participants	Job title	RACE GROUP				GENDER		AGE GROUPS					TOTAL YRS EXPERIENCE	QUALIFICATION DISCIPLINE
			A	C	W	I	FEMALE	MALE	18 - 25	26 - 35	36 - 45	46 - 55	56 - +	Years of experience	Qualification
1	FinC	Technical Support		1				1		1				7yrs	BTech: Civil Eng. (Water)
2	NtsiM	Technical Support	1					1		1				1yr	Ndip: Elec Eng.
3	PS	Field Technician	1					1		1				9	Ndip: Elec Eng.
4	TM	Private Utility Operator	1				1			1				1yr	Ndip: Elec Eng.
5	TV	Smart Metering Specialist		1				1				1		more than 10yrs	Btech: Elec Eng.
6	YS	Service Support Technician	1				1			1				9yrs	Ndip: Elec Eng.
7	AM	Operations Coordinator		1				1			1			18yrs	Btech: IT
8	RH	Business Development Manager		1				1			1			2yrs	N4 - Electrical Eng. Certificate
9	BM	Technical Key Account Manager	1					1		1					Ndip: Elec Eng.
10	DS	Business Development Manager	1					1			1			more than 5yrs	Ndip: IT
11	FC	Sales Representative		1			1				1			15yrs	Bcom Honors: Public & Development Management
12	IL	Business Development Manager		1				1				1		22yrs	N/A
13	SR	Business Development Manager				1		1			1			14 - 15yrs	Ndip: Elec Eng.
14	BW	Operations Manager			1			1					1	14yrs	Btech: Finance
15	GP	Smart Technical Centre Manager		1				1			1			12 yrs	Btech: Elec Eng.
			6	7	1	1	3	12	0	6	6	2	1		

Table 4.5.2 Female representation in the private utility sector

Respondent	Participants	Job title	RACE GROUP				GENDER		AGE GROUPS				
			A	C	W	I	FEMALE	MALE	18 - 25	26 - 35	36 - 45	46 - 55	56 - +
1	FinC	Technical Support		1				1		1			
2	NtsiM	Technical Support	1					1		1			
3	PS	Field Technician	1					1		1			
4	TM	Private Utility Operator	1				1			1			
5	TV	Smart Metering Specialist		1				1				1	
6	YS	Service Support Technician	1				1			1			
7	AM	Operations Coordinator		1				1			1		
8	RH	Business Development Manager		1				1			1		
9	BM	Technical Key Account Manager	1					1		1			
10	DS	Business Development Manager	1					1			1		
11	FC	Sales Representative		1			1				1		
12	IL	Business Development Manager		1				1				1	
13	SR	Business Development Manager				1		1			1		
14	BW	Operations Manager			1			1					1
15	GP	Smart Technical Centre Manager		1				1			1		
			6	7	1	1	3	12	0	6	6	2	1

Furthermore, digital utilities are associated with product variety and service. NtsM itemise their product and services to include electricity and communication, which favour the supply of electricity, water and gas. TV explained further that these services are provided both in public and private utility industry.

The job description for managing Society 5.0 digital utilities involves supervision of digital services associated with smart metering. This includes a range of activities, from the initial startup installation and configuration to the ongoing maintenance of the back-end system. This was the view of TV. In support of this view, GP explained further that smart technical centre consists of eight individuals: a clerk, tariff section, a water specialist, a metering specialist, someone who has an overview of the systems, a technical consultant working on a contractual basis, who helps to manage the customer. This team also includes retired staff who train students.

GP priorities job and helps with resolving queries. In line with GP, TM said she is literally assisting customers when they have problems with their meters. PS found specialisation in electrical installations, inspections, replacements, and other tasks such as energy balancing and liaising with the municipality. Other participants who have similar specialisations include NtsM, YS, BW. The efficiency of work performance depends largely on the individual involved in the service.

Nevertheless, the place of cooperation and togetherness among the department in utilising Society 5.0 cannot be overlooked. The technological adoption in the various departments differs but through cooperation, no department will be left out in development capacity. Various departments identified by the participants include smart technical centres, public operations, public and private utilities. Society 5.0 can further be assisted by individual who have other managerial capacity apart from its area of specialisation. This individual has the tendency of stirring up digital utilities in the organisation.

Digital utilities in Society 5.0 require years of experience in the field of set qualifications. TV is more proficient than FinC. This is because TV has more years of experience in the field of qualification than FinC. Years of experience in the field of qualification go with upskilling. Consistent upskilling in the field of qualification enhances potential development. The digital smart society requires certain professions such as electrical engineering, civil engineering, management, and finance. Most participants are in possession of National Diplomas. Other qualifications possessed by the participants include bachelors and postgraduate diplomas, and background information is required to assess smart society suitability.

Table 4.5.3:Qualifications of the group

Respondent	Participants	Job title	HIGHTEST QUALIFICATION ACHIEVED				QUALIFICATION DISCIPLINE
			Matric	NDip	BTech	Post grad	Qualification
1	FinC	Technical Support			1		BTech: Civil Eng. (Water)
2	NtsiM	Technical Support		1			NDip: Elec Eng.
3	PS	Field Technician		1			NDip: Elec Eng.
4	TM	Private Utility Operator		1			NDip: Elec Eng.
5	TV	Smart Metering Specialist			1		BTech: Elec Eng.
6	YS	Service Support Technician		1			Ndip: Elec Eng.
7	AM	Operations Coordinator			1		BTech: IT
8	RH	Business Development Manager	1				N4 - Electrical Eng. Certificate
9	BM	Technical Key Account Manager		1			NDip: Elec Eng.
10	DS	Business Development Manager		1			NDip: IT
11	FC	Sales Representative				1	BCom Honours: Public & Development Management
12	IL	Business Development Manager	1				N/A
13	SR	Business Development Manager		1			Ndip: Elec Eng.
14	BW	Operations Manager			1		BTech: Finance
15	GP	Smart Technical Centre Manager			1		BTech: Elec Eng.
			2	**7**	**5**	**1**	

Table 4.5.4: Themes

Theme 1	Digital infrastructure required to position private utility to benefit from society 5.0
Subtheme 1	Smart technology infrastructure for Society 5.0 I. Smart Grid II. Microgrid III. Virtual power plant
Subtheme 2	Information Communication technologies that enhance digital infrastructure
Theme 2	Accessing organisational skill readiness to partake in Society 5.0
Theme 3	Assessing private utility organisations readiness for Society 5.0 innovation?
Subtheme 1	Organisational workforce knowledge level on 4th and 5th industrial revolutions
Subtheme 2	Organisational projection and readiness to embrace the changes from Society 5.0
Theme 4	Organisational strategies in preparation for society 5.0
Subtheme 1	Assessing administrative strategy in readiness for society 5.0 I. Planned and automated processes to reduce delay in the system II. Evaluation, projection, and preparation III. Capacity building
Subtheme 2	Technical strategies and technology adoption in readiness for Society 5.0
Theme 5	What are the skills needed to effectively position for society 5.0?
Theme 6	What are the foreseeable changes in the private utility as a result of smart society?
Subtheme 1	What is the use of Blockchain technology for smart grid billing system?

Theme 7	Challenges hindering private utility to prepare and embrace society 5.0
Subtheme 1	Administrative and people challenge a) Fear, resistance, and slow adoption of smart society changes b) Stakeholders incorporative and unwilling to invest. c) Environmental access and security challenge
Subtheme 2	Technical challenges a) Technology age and new technology adoption b) Cost implications and technology/infrastructure availability
Theme 8	Cyber security

4.6. Theme one: Digital infrastructure required to position private utility to benefit from Society 5.0

In accordance with the data collection for a private utility to be positioned to benefit from digital infrastructure, the private utility must be familiar with the uses and applications of digital infrastructure in order to have access to it. Most of the time, these digital infrastructures are server- and cloud based. Some of the digital infrastructures identified include smart meter, Sigfox and LoRa, LoRaWAN ACEPilot, data concentrators, modems, etc. There are a combination of IoT devices specifically used for communication called Guage IT, a smart water device. Most of these devices are connected to the server. Smart metering is a measuring device capable of providing relevant information on the back-end system with administrators, business users and consumers. PNP Scada, used to monitor consumption, provides trends analysis and can be utilised for the purpose of billing and reporting. It gives notifications when there are spikes. Vending systems are used for sending tokens online.

Sigfox offers seamless worldwide connectivity. It delivers nearly 80 million messages per day. It is a network that transmits information from the devices to the internet but at a low data rate. It is a wireless interface developed to enable communications with minimum power consumption, using a simple battery that will last for several years. This battery is sufficient to power the device. Similarly, LoRaWAN is a cost-effective connectivity for devices that do not require high volume data transmission. It requires low power and wide range. A series of smart meters is combined into a single device using data concentrators. It makes the process of collecting data from smart meters easier. It performs the function of concentrating and managing communication. It therefore reduces the overall cost of operations. This, however, expresses the general view of participant PS, FinC, GP, BW, DS, FC and TV. They acknowledge the relevant uses and application of the various digital infrastructures mentioned.

4.6.1. Subtheme One: Smart Technology Infrastructure for Society 5.0

4.6.1.1 Smart grid

The amount of electricity sent to residential, network, small-scale energy distribution and storage devices is determined by a smart grid. It gathers data on costs and grid conditions, and it transmits information on operating status and requirements. It regulates the grid's movement to a determinate point of operation. Through the use of computer technology, the smart grid enhances the connectivity, automation, and communication between the various power network components. Industry 5.0 is all about the integration of multiple sources of utility into one platform for easy operation and management. Confirming what a smart grid entails, some of the participants stated:

> *Smart grid would be a combination of the Eskom grid and an additional supply and the management of that connection. Basically, smart grids are the future (PS)*
>
> *Smart grid is where everything is interconnected when you have your solar system and then it feeds back to the grid (YS)*

On account of the present pressure in the national power grid, one of the participants said:

> *We need a smart grid system that will be able to move away from the National Grid to cater for the masses because the only problem we are facing right now is the National Grid being under pressure. (NtsM)*
>
> *So smart grids allow for an integration of different energy sources into one, to serve basically the end user, so that basically means downtimes would [be] much lower if we would have more smart grids (PS).*

Smart grid is an essential infrastructure in a Super Smart City, supporting the installation of smart meters in homes and business performing dual purpose metering. Participants (PS, YS, and NtsM) expressed a positive view about the smart grid; however, they are sceptical about its implementation at this stage of their operation and with the technology within their reach. Some of the participants stated:

> *I don't think that we are in that space because that needs meter, that does dual metering electricity, that is from Eskom and from additional grids like from solar plants (PS).*

TV said:

> *There's been an update of smart devices which incorporates different resources, whether it's gas, electricity, water in the market, that actually does that using different communication technologies, so it is just a matter of maybe bringing it all together (TV)*

This digital device may communicate in both directions, saving process time by conveying information about supply and demand between producers and customers. The smart grid's ability to operate depends on the data that smart meters gather. BW added:

> *…the meters' integration from meters to heating systems to meter management systems, getting data out and interacting with the customers, collection of the monies and all of that, so all that integration is start happening (BW)*

Supporting this, TM stated about smart grid technology:

> *Actually, save us a lot of time if we go that route. There's lots of things that needs to be done and there isn't so many hours in the day (TM).*

As a benefit to the private utilities organisations, PS posited:

> *I think that that would have more benefit for the organisation, where we sort of do generation of energy, and then we do the metering and then we do the supply. I think that would be, that would be nice. The freedom of that makes so much money (PS)*

Despite the utility management advantage of a smart grid, the participants feel it is not being embraced yet owing to the cost implications and the unavailability of technology to integrate multiple energy sources, say electricity, from coal power plants like Eskom and that from renewable energy sources. These sentiments became evident from the responses gathered from the participants.

4.6.1.2 Microgrid

A microgrid is a digital infrastructure required by a private utility to be able to cope with Society 5.0. A microgrid is a collection of distributed energy resources and associated loads that functions as a single, controllable unit in relation to the grid. It can function in grid-connected mode or Island mode by connecting and disconnecting from the grid. Customer resilience and dependability on grid distribution can be enhanced by microgrids. This is the only option, according to one person, that should be investigated.

> *Although there are not many that I know, they are still efficient to private utilities (MtsM)*

Also, most particularly, it provides relief to areas without the National Grid. One participant stated:

> *Microgrids are actually very applicable in areas where you don't have access to electricity, and you need to deploy. It is planted off the grid. So, these are not grid tied and that is where it comes in very handy. We have a, we have these grids that we can actually apply to meet the need of, let's say, a remote area and base your microgrid on a renewable supply (TV)*

A microgrid facilitates the integration of the expanding deployment of dispersed energy resources, such as renewable energy sources like solar power, to support an adaptable and efficient electric grid. Reducing energy losses in transmission and distribution is another benefit of using local energy sources to support local demands. Further increases efficiency of electric delivery system were adopted from the view of PS, FinC, GP, BW, FC and TV. On the downside of the infrastructure, smart grid system came with other environmental challenges, as expressed by one participant, who said:

> *Takes you away from the inconvenience that our current provider Eskom is giving us, but at the same time, if we look at it from an environmental perspective. What happens to your batteries and your solar panel that's on your house after 5 to10 years? How do you get rid of those? Does that acid and that go back into the ground, back into the environment and we cause environmental damage again. Besides the fact that they're quite expensive (GP)*

4.6.1.3 Virtual power plant

Virtual power plant is a renewable energy electrical device that can enhance rapid development in Society 5.0. On the other hand, virtual power plants balance the supply and demand for energy. They employ networks to link homes and their batteries in order to control energy flow and lessen grid resilience during periods of increased demand. The dependable supply of solar energy produced by virtual power plants not only helps to stabilised the electricity grid but also provides a more sustainable energy solution than conventional power. A virtual power plant reduces reliance on coal power. More independence is made possible for the consumer from their local utility. With the help of sporadic renewable energy sources like solar and wind power, they offer a dependable supply. This is in line with the opinions of PS, FinC, GP, BW, FC and TV.

> *I think virtual power plants in the private utility space could be more beneficial in terms of, now it's up to a utility to be off the grid. Because now, with the advancement in*

technology, we don't need the on and off. Instruments that we're using for technology don't necessarily handle the pressure of being like on and off because they could be surge current, they could be overcurrent, so virtual power plants could be beneficial to those instruments and could be beneficial for the private utility space as well (NtsM).

4.6.2 Subtheme Two: Information communication technologies that enhances digital infrastructure

The digital infrastructure is a tool for effective communication. (TV) indicated that GSM mobile network has changed to accommodate faster speed communication. Many organisations are not aware of smart devices. We currently have up to 5G. It is obvious that there has been slow progress at incorporating smart devices onto the power grid or the smart grid system. In view of this, any organisation that fails to upgrade to smart device will not be able to cope with 4IR. TV said: even radio-based, or radio frequency is now moving onto internet modem-based 3G, 4G, 5G. (FinC) emphasised that the use of wireless space is inserted into modems. There have been many devices in the market that actually use different communication technologies. Supporting this view, TV mentioned some of these digital infrastructures. These include smart metering, Sigfox and LoRa, LoRaWAN. Taking it further, there is narrowband internet as well as NBIoT. GP made it clear that the old technology is being replaced at a faster rate with NBIoT. There is a wide range of these smart devices in the market that can accommodate everyone. TV acknowledge that there has been an update of smart devices which incorporate different resources such as gas, electricity, and water. BW and GP reiterated that in the past a smart device was only one way; now we have both-way communication. There is therefore no excuse not to take advantage of information communication technologies.

4.7 Theme Two: Accessing organisational skill readiness for Society 5.0

Another element that emanates from the data collected is the issue of organisational workforce skill level and the preparation through training for the changes coming from the 4th and 5th industrial revolutions. As a determining factor for any organisation to participate in the super smart society, they must perceive the change that is to come and prepare their workforce ahead of the change. Accessing the skill, TM, PS, NtsM, SR, and FinC emphasised that their organisational workforce is well skilled and ready to participate and compete favourably in the smart community. Supporting this view, TM, FinC, and PS posited that the organisation has the skill set for the future. Taking it further, PS said that counting the combined years of experience of the workforce is a positive factor for effective participation. Supporting this, FinC reiterated that the team is well skilled in what they do. FinC and PS acknowledged that there is a need for more continuous upskilling and to increase the number of skilled workers.

Furthermore, the company should lead the way towards skill readiness, and all of these comments were made evident through the response below:

> *We have sufficient skills, but we do still need to get, we need to upskill basically, we need to make it something like a common language to talk about these things because for some people it, might not even be something they know that the company is interested in moving towards, but it's basically the environment that is moving us towards that. So, without seeing the initiatives from the company to educate people, to train people and also to share that they've got vision, a vision for fifth industrial revolution, I don't think we are entirely there, but what with the capabilities of the workforce, if we can have set goals, set strategies, I think we could definitely be entirely ready* (PS).

> *I think with the advancement of the system and the background knowledge that we have, we are moving in the right direction"(NtsM).*

Some of the participants had the view that the organisation is neither fully prepared nor completely without adequate skill readiness level. Their views are:

> *Yes and no. Yes, in that they understand the need for automation. They understand why it would be better. The theoretical understanding is why it needs to be there. The implementation part of it is not happening*, we are 50/60% *ready, of course we can still do more we've done a lot of good in that space, a lot of challenges has materialised, but I think we are almost at the forefront to a certain extent.*

In contrast, GP, YS, and BW think that they are not skill ready:

> *I don't think they are ready; we need to invest a lot in skill development to make sure we stay in line with technology to support the whole smart drive that's gonna come*

> *In terms of workforce, I don't know if we are ready. I really believe that a lot of people need [to] understand first the whole concept about smart grid and mass smart cities.*

4.8. Theme Three: Assessing private utility organisations readiness for Society 5.0 innovation?

4.8.1 Subtheme One: Organisational workforce knowledge level on 4th and 5th industrial revolution

The knowledge level of the organisational workforce is essential to embrace change in 4th and 5th industrial revolutions. Assessing digital utilities requires a bridge in the knowledge gap. However, knowledge is a directional power. In a situation where people lack knowledge, abuse is inevitable. . Adequate knowledge is required for development in Society 5.0. PS identified that the 4th and 5th industrial revolution is a technologically based environment where things are connected via the internet and digital infrastructure is the order of the day. But where participants are not grounded in this technology, they might not be able to tap into its use fully. This is an attribute of participant PS and NtsM who have little idea about 4th and 5th industrial revolutions. In other words, ignorance is a disease. It is a limitation to development. Most of the participants are not familiar with 4th and 5th industrial revolutions. Some are hearing about it for the first time while some are not sure what it is all about. This attribute was found with TV, TM, BV, FinC, YS, GP and BW.

4.8.2 Subtheme Two: Organisational projection and readiness to embrace the changes from Society 5.0

Organisational readiness to embrace change from Society 5.0 is their ability to project beyond the present. However, change is constant. BV declared that any organisation that does not embrace change is not ready to go beyond the present. It was further emphasised by (GP) that change can only be acquired through organisational projection. To embrace change, (TM) said that the management team must have understood where they are coming from, where they are going and what they need to get better. To further support this, (BW) said that investment must be made into skills development ensure they are in line with smart technology drive. Taking it further, (GP) said that any organisation that craves change must see a reason to push and consistently grow themselves. They must be familiar with the recent changes in the market. More so, upskilling must be their priority. (BW) said that they must be ready to provide solutions to customer complaints. With respect to the readiness of participants to embrace change, TM strongly believes that they are not far from ready to use smart technology. They only require a few trainings. Supporting this view, (PS) said they are already using some of the smart technologies. Similarly, the manpower of the private utility in the study said that they are more than capable. With their years of experience in the field, they are well equipped. They are ready to take on the world.

4.8.2.1. Renewable energy acceptance

Renewable energy is a sustainable technology that can enhance development. The participants agreed that renewable energy is an independent power system. To access renewable energy (PS) said the existing infrastructure must not be hindered. The projections of all participants give an indication that renewable energy is an energy production source that needs to be explored further. Although its adoption might be slow owing to the cost implication and lack of awareness, renewable energy is seen by all as the energy that will rule tomorrow's utility industry, as explored by the opinions of the participants:

If you look within the utility space, a renewable energy will be of used to a very large extent (NtsM).

*Renewable energy can be embraced, it will be well embraced, though there might be the challenges with cost. The cost might take a while to normalise (*TV).

In support of accepting renewable energy:

If we look at how things are going right now with Eskom… They were talking about stage 15, I don't know what that is. In the real sense of it, we need to start looking into renewable energies (TM).

In support of the above opinion, FinC said:

Most of the new developments are coming out with their own solar panels. Solar energy is quite a big thing that is being produced in the utility of space. It provides full electricity. Renewable is already well embraced in terms of private development (FinC).

Renewable energy is something that we're looking into. This municipality is actually ahead. I don't know of the rest municipalities.

It was, however, declared by DS:

My perception is this, this is a good thing. Change is good. You can't be stagnant.

4.9 Theme Four: Organisational strategies in preparation for Society 5.0

To fully engage in the fourth and fifth industrial revolutions, organisations need to devise plans that will guide them toward gaining the necessary skills and knowledge for their respective industries. It shows the need to plan and map a clear path leading to a successful outcome. For it to be considered effective, it must cut across all key aspects of the business. The findings indicate two broad themes from the participants' responses to address this aspect of the research.

4.9.1. Subtheme One: Assessing administrative strategy in readiness for Society 5.0

This is an important factor and the foundation of all moves to be implemented by an organisation if they want to be able to build up themselves towards participating in Society 5.0.

Administrative strategy entails planning, organising, controlling, and all other activities that will enhance their readiness. To start with, the organisation must declare their goal and all stakeholders involved must be informed about the move to get them prepared. This was the opinion of YS, who said that people should be made aware about the moves and the opportunities that come with it, so that they commit their minds and prepare themselves for the changes to come. Sharing the same sentiment, FC said:

> *If people are fully informed of where Society 5.0 will take us, what are the implications? The fear of the unknown is taken away and therefore people will be more easy, open to embracing the changes to Society 5.0 (FC)*

As stated, the awareness campaign should include the end users to bring them up to speed with the staff servicing them about other important aspects in a thorough assessment of the current situation of things as opposed to the required standard of things in Society 5.0.

4.9.2. Planned and automate processes to reduce delay in the system

One characteristic of a smart society is a seamless flow of activities without administrative bottlenecks, cutting across all aspects of the company operations. According to GP, "There's a lot of manual work that we're doing that we're actually looking at; how do we automate various processes". To be specific, PS pointed out the delays to attend to customers' queries because they must be routed via the service desk and then routed via other departments before the customer will be assisted. Meanwhile, the need could be met by just few clicks.

4.9.2.1. Subtheme Two: What is the use of blockchain technology for smart grid billing system

The data collected revealed blockchain as an integral part of modern technology for society 5.0 in the 4th industrial revolutions. It uses smart grid billing system. Blockchain is a metering and a billing device for a customer electric network. It is a streamlined and integrated process with data sensitivity and control. It enables users to maximise opportunity and reduce time wasted. It facilitates the payment process and verifies transaction made. It provides a safe and more transparent solution with a decentralised structure. There is a need to get people acquainted with the technology and to explore how beneficial it will be when incorporated into the utility space. The participants interviewed are, however, not clued up as to what the technology is all about. These were their statements:

> *Many people have no clue of what blockchain is all about (SR).*

Blockchain is complex but effective if properly adopted by creating an understanding into its uses. Blockchain can effectively change the space. It can change the private utility space as a whole as we geared toward 4IR and 5IR (NtsM)

We are geared towards blockchain. It would be interesting to see how we can utilise the space to maximise opportunity. Another thing here is trading of grid billing. This can be utilised in peer-to-peer trading. For instance, you can sell excess energy you don't need to your friend or to your family. You can also sell it to grid. In this case, you are safe grid, minimising the usage of grid, as well as providing for your friends and moving away from the National Grid (NtsM).

Trading mechanism in smart technology might become cryptocurrency (GP).

Private organisations must foresee accepting blockchain because the migration to blockchain service is not too big. It plays a significant role in space availability for the private utility (TV). This imminent technology includes the use of Sigfox, NBIoT meter and the E-meter, PNP SCADA, wireless space where we insert modems, 3G cards, 4G cards for connectivity known as communication software recently adopted by mobile service providers (IL). If a private utility does not adopt the use of these technological changes, such an organisation will automatically become outdated.

It's a great opportunity specifically within South Africa and the challenges we have, I think empowering the consumer effectively to potentially have that power in their hands and be self-sufficient and be able to address the problem (SR)

From the perspective of regulation, most of the participants expressed concerns about the issues regarding who to regulate the use of the microgrids.

4.10. Evaluation, projection and preparation

Another administrative necessity to get an organisation prepared is to evaluate their current situation of things in terms of where they are going. This will enable them to know what to do to get there. This was the exact finding from the responses of GP, SR, and PS. There is a need to do analysis and, with the findings, products or processes are discontinued. Then new products come (PS). According to GP, they had to set up a solution team charged with the responsibility to perform this task.

So, what we've done, we've actually looked ahead. We've got our current work set, we've got our current contracts, we've got our current customer base we need to look at, but we also looking and building tools for the future, what is out there. So outside *of the technical team, there is a solutions team that looks into the future. What solutions are out there? And with the STC's help as well, how can certain things work? So, we are looking around. It's a lot of reading and a lot of studying to see what is out there to make us to continually not just be relevant but to be the leaders in that field. (GP)*

Supporting this, SR and RH said:

We try to understand what's happening out there from an electrical and water space, trying to understand where our customers are going, what's their end vision, and try to gear ourselves up to actually meet those needs (SR).

We have interactions with customers that we have and by learning from them and their expectations, it kind of forced us to adapt our system to meet their requirements (RH)

4.11 Capacity building

Building capacity across the team and the clientele (end users) is necessary at this stage and should be adopted as a strategy to gearing up for the society in question. PS strongly recommended that organisations should look into organising training sessions with key areas that capacitate the workers to prepare them for the task ahead.

One thing that they can do is have a training department. And the one thing that they can also do is every time there is something new coming into the business, be it a product, be it a service, be it a solution, get people in the training room and train them because in many cases we have to figure things out, and it's not always easy. (PS)

PS further maintained that, although based on experience, skilled workers can read the manual of new equipment and use them, but training is still necessary because "certain things will translate differently through training". In support and from the customers' perspective, findings from DS's response indicate that building capacity should not be one-sided. The end users are also stakeholders holding the other side of the rope. Training them in terms of what they need to know to use the services being provided effectively, makes life easier for the organisation.

If the team can be 10 steps ahead and the customers are 10 steps behind, it also becomes a problem because when you speak to the guys, they don't understand what you're talking about. So, we need to bring them along as we capacitate this skill, but we must also capacitate the people that we are doing business with, so we must bring them along (DS).

The organisation not only provides services to respond strictly to their requirements regarding the gadgets and utility but also taught the end users on how to help themselves to access useful information. This was done as a means to ease up the workload and make it people- and data-centred as it is supposed to be in the smart society. This was the response from YS

> *But we take it to the level of the consumer where we provide the, take energy application that they can use on the phone to check your consumption, check your, pay your bills. Also, we go to the level of providing the end consumers with a course and link them with the tool that, it's readily available for them to download and they can just buy their electricity from there (YS)*

Building capacity also involves identifying your areas of strength and going into partnership with other organisations whose strength lies in the areas of your weakness. The findings indicates that organisations are exploring and maximising the advantages this brings. From IL:

> *We know that communication infrastructure is not our strength. So, we have partnered with certain tech companies, be it metering companies or communication companies (IL).*

4.11.1 Subtheme One: Technical strategies and technology adoption in readiness for Society 5.0

Considering the line of business, a private utility company must ensure an adequate technical strategy that will propel them and leave them with strong competitive advantage against their opponents. Assessing the strategies they have adopted so far, the findings showed that they are projecting to the future already even while they are still using the old technologies. This sentiment was shared by TM, acknowledging that they are heavily operating on old manual meters where the only way to get a reading is to go to the meter for a view. They said further that they are looking into the future and are identifying meters like the Wasion electricity meter which enables them to take reading from the office just by putting it on live view. Adding to this, NtsM said:

> *We've got an AMR system, automatic meter reading system, we've got an automatic meter investigation system. We use PNP SCADA, we've got a lot of systems that we use that are gearing towards 4IR (NtsM)*

In terms of the billing part of the business, to fit into the smart society, they have moved from pre-payment system to thin pre-payment system where end users can top up their utilities from anywhere around the world (NtsM). To enable seamless operation of the system they identified some network and communication devices (Urbanise, modem; 3G, 4G, and 5G cards) matching the standards for the smart society. Some of these devices help them to monitor their meters remotely by integrating all of this through some network systems and physically based system, enhancing their work.

From the responses, these extracts were drawn:

> *We have a software called Urbanise which you can upload all the meters that you need to read for monitoring and then there's also live view. You can actually go on live view and see what's happening with the meter (TM)*

> *So based on the current setup we're all working on, radio frequency, which is your Sigfox basically. Now we're moving over also to the wireless space where we having to insert now modems, 3G cards, 4G cards, we even busy testing 5G cards for connectivity also. FinC*

> *…modem then speaks to a heading system, which is cloud based, and then from the heading system that is then going into a portal that manages your vending for you. Inside that portal that manages that vending for you, it calculates your tariffs, it does all your billing calculations (GP)*

Participants provided insights into their strategic evolution, offering a glimpse into the journey and phases they've encountered. The reflection covers both technological progress and changes in user perspectives. The service providers' quest is to provide better service in response to the user demand. BW, and IL responses on this are:

> *If I just think over the last 10 years how our vending has evolved from initially municipalities themselves to all kind of vendors and now it's basically with the online system where customers can basically buy anywhere, anytime, 24 hours and it's really convenience driven. So customers shouldn't have an excuse why they can't settle (BW)*

> *Companies looked at both from a product perspective, looking at products that gives them the ability to access information on an almost or near real-time basis, which is now from a water metering perspective, our static water meter with built in communication. And even the electricity meters, we are looking at ways in which we can access information near real time (IL)*

4.12. Theme five: What are the skills needed to effectively position for Society 5.0

There are specific skills that are essential for individuals to be effective and well prepared for Society 5.0. When some of these of skills are lacking, job functionality and performance maybe be hindered. To achieve this, as maintained by the participants, irrespective of the department you work in:

> *… basic electrical fundamental, knowledge on applying these fundamental is very important to further buttress this (PS)*
>
> *You do not need to have a deep understanding nor of the detail, but you need to understand how it works, how it impacts your customer. What is the outcome? All of that you need the basics, you need to understand that, yeah (BW)*
>
> *I fortunately or unfortunately do need to have some level of technical know-how or understanding at least. …technical skill, because I also need to interpret certain product specifications and match those specifications against customer requirements and also based on what's in our business basket from an offering point of view (IL).*
>
> *I think for this particular role, it would be good for you to understand the electricity stuff that is happening, the water stuff, the gas stuff because you know, the solutions that we are selling (DS)*
>
> *An overall engineering or technical-minded thinking. You should have an overall experience in electricity and flow of current and the measuring, metering of current as that is the type of customers that you are dealing with daily with those type of experiences (RH).*

There are some skills that you do not learn at school, but you learn in the field, which are basically from an engineering background. The participants posited that you need to be familiar with some other soft skills:

> *But when you get to site, you need to then have some other skills like, interpersonal skills, you need to have customer service skills, you need to have a way to speak to customers, speak to contractors and all that stuff with some level of communication skills (PS) On the computer side computer skills as well as data analysis* (PS)

Taking it further, three participants stated:

So, it's important to understand the capability of what the product can do and also to understand how you configure that product for the customer use, customer application (TV)

You need to understand when someone is talking about the business side and the activities:

So you have to understand how meters work. You have to understand when someone talks about consumption, meter consumption, you have to understand what that is, so it does require a certain extent of technical understanding (YS).

Technical knowledge of the field and report writing (FinC)

4.13. Theme Six: What are the foreseeable changes in the private utility as a result of a smart society

Another relevant point noted from data collection is the foreseen changes in private utility through the introduction of smart society. Owing to 4th and 5th industrial revolutions, there have been a number of innovations in smart energy infrastructure. The views were that private organisations involved in consumer, producer, and provider needs must balance the operation of the grid to optimise change. Then consumers will be integrated into the circle of energy production and monitoring. The participants alluded to this and are projecting:

I foresee that happening in the future, in the private sector where consumers will start producing energy power, a renewable that is being part of the grid, independent or off-grid connections. Then the mechanisms to measure that, we have to adapt as a company (TV).

Most of the back end will fall on the client side. Instead of company monitoring, clients will have access to all that stuff physically or virtually in front of them, where they will be able to monitor, control everything according to what they want and how they set it. In terms of all these portals we are capable of viewing, they will be able to view ourselves (FinC).

In terms of the rate of technological advancement and everything moving online:

You can do everything remotely; you can literally read everything remotely. You don't have to physically go there to access data on your meters. I actually see this happening (TM).

Supporting this view from an integrated platform angle, one of the participants said:

With all these other technologies that have been deployed now, I can see we are moving with the wallet that has been rolled out in Joburg. I think we're moving towards that direction, so it's something I wish would go everywhere, where people can be disconnected from the back end and everything can be, all the utilities can be managed from one point as opposed to having multiple prepaid meters (PS)

Change is imminent, and any organisation that refuses to foresee changes will not be able to cope in the smart society.

4.14. Theme Seven: Challenges hindering private utility to prepare and embrace Society 5.0

Two broad challenges were identified as causing or that would pose hindrances to private utilities in meeting the requirements of remaining competitive in the Society 5.0 community. Of note are administrative and technical challenges.

4.14.1 Subtheme One: Administrative and people challenge

The role of administration is crucial in guiding organisations towards successful strategy implementation for the shift to a smart society. However, obstacles within administration have been recognised, leading to the emergence of three sub-themes: stakeholder fear, resistance, and sluggish adoption of smart society changes; stakeholder reluctance to invest; and challenges associated with environmental access and security.

4.14.1.1 Fear, resistance and slow adoption of smart society changes

The move to a smart society is causing changes in virtually all aspects of life and the nature of humans is always being resistant to change. Resistance to change is another factor causing the slow adoption of the changes coming with the smart society. This is because "there are many people that are scared to make a change" (GP). Participants (IL, SR, and FC) shared the same sentiment with GP. According to IL,

…we are creatures of habit as human beings, and technology is advancing at such a rapid rate, and change by nature scares people or puts them in a bit of an anxious state or space. So people's willingness to embrace this change is not entirely there yet… In resisting this change, technical administrative team are not missing out (IL).

On this, PS responded, saying:

We have a technical team in in our municipality that is somewhat standing in the way of moving forward. No matter what solution you can bring to them, they already have *a problem of why it will not work and any customer we approach they refuse to come to the party (PS).*

SR added about the push and pull of people who are not ready or who are unwilling to embrace and make the change when you are trying to push something through. The participants collectively agree that this resistance is more at the decision-making level and among the decision-makers. YS had it that administrative processes cause delays in virtually every aspect of their operations and implementation of things; hence the slow pace of making changes.

4.14.1.2 Stakeholders being uncooperative or unwilling to invest

Another challenge identified that plays a role in limiting private utility from advancing towards a smart society is the unwillingness by the customers and other stakeholders to commit funds to make the change happen. Certainly, the incorporation of the stakeholders is needed because the implementation of the strategies leading to the era of smart technology is being made by the organisations since it involves high investment costs. This was the view of RH who relates it further to the economy, stating that the state of the economy also influences the decision made by the stakeholder. In their words, "…but everybody is not ready to pay that much money and to invest that much into solar, for instance".

4.14.1.3. Environmental access and security challenge

Implementing these changes that will see private utilities well positioned to participate in this society to come, means complete overhauling of the system needs to be done in all areas of the country. The state of the security problem in some areas in a country like South Africa makes it difficult to implement new technologies as these areas are unsafe to access by the team. YS held this view, stating "there are some areas out there that are not really safe" and cannot be accessed easily. The issues of uneven distribution of infrastructures was stressed by DS who stated the rural areas should be targeted as well and not just the towns and metros.

4.14.2. Subtheme Two: Technical challenges

Technical expertise forms the backbone of a smart society, yet it also represents a significant challenge for organisations striving to meet societal standards. On examination, four themes were identified in responding to the technical aspect of the private utility readiness to operate favourably within the community in a smart society. This includes the technology age and new technology adoption; skills of the organisational workforce; the rate of technological advancement; and technology availability and readiness.

4.14.2.1. Technology age and new technology adoption

A smart society is a highly technologically dense era characterised by data and information flow, driven by humans without physical contacts. Assessing the technology of an organisation operating in the private utility space indicated that they are still operating on systems that struggle to keep up with the trends of the incoming society. Also, there is slow adoption of the already available technologies. As gathered from some of the participants, some of their technical infrastructure in use is struggling to cope with the new demand. This was in line with NtsM challenges with a thin pre-payment system that registers errors and fails to bill the customers thereby affecting the company's revenue. In support, YS posited that even with the new technology, most of the time when audits are captured by the team, the system fails to register all the coordinates and when those will be queried. They further submitted that to carry out the audit, the team must go to the customers' homes where, in some cases, there is failed access. TV posited that there is existing infrastructure which could do better but "it is difficult just to swap out or change over to newest technology"

> *Thin pre-payment is challenging because you don't have room for error. If you do not bill, if that modem is not working and it was never interrogating, the bill for the customer will not go through. And if it affects the bill not going through it affects the end customer and it affects the body corporate that the customer resides in and affects the company as well in terms of revenue (NtsM).*

> *So when the teams capture the audit, it's captured automatically so that they don't have to type it in themselves but at the moment there are jobs that come without GPS coordinates (YS)*

On the communication and network devices which currently mainly run on battery, FinC said: "Some of the towers are battery powered and with the current stage of load shedding they do tend to switch off. Hence, our meters can't communicate to the towers". They emphasised the effect this has on their meter interrogation and data retrieval which is the order of things in a smart society. Taking it further, GP indicated that the use of modern currently delays the process as it can only communicate with one meter at a time.

> *So, if you a site got 10 meters, and you're doing hourly reads, it will take you 10 hours. If I go into something that's maybe a bit later than a modem, it's called a concentrator or a DCU. The way that that works again is going to be, your DCU can speak to multiple meters at the same time. Which obviously means it can speak to all 10 meters at the*

same time, pull that information through, which means that the consumer on the other end, his wallet we updated automatically more frequently (GP).

On documentation, PS lamented the challenges of manual archiving, sorting, and retrieving especially when it related to document with multiple versions.

We need somehow more automated system and portal to manage documents and send notification to everyone involved when the document is updated.

4.14.2.2. Cost implications and technology/infrastructure availability

The private utility organisations are mainly not producers of technology and some technologies required to deploy to enable the implementation of processes are not yet in the market. RH has this view stating that their "company might be very advanced in our thinking or towards where we need to be, but then certain technologies are not ready". Most of the participants acknowledged that smart grid infrastructure brings so many advantages; however, the initial cost of establishing it is a limiting factor. RH and BW maintained that people talk about renewable energy but are not ready to pay the huge cost involve. TM

4.15. Theme Eight: Cyber security

The use of cyber security in 4IR is a new-age technology. The protection against access to unauthorised data and computer systems is required for private utility in 4IR and 5IR. Even though many individuals and organisations are familiar with cloud storage, PS still maintained the traditional way of storing things is in local machines or local space. This conception was based on the activities of hackers and fraudsters in the cloud. It was further made clear that the fraudsters are smart and professionally inclined. In contrast to this opinion, it was stated that the risk of losing all of your data when the machine is damaged is not as bad as the activities of hackers. In view of this, it was identified that data security must be tight to keep information secure in the cloud.

4.16. Summary and conclusion

The purpose of this chapter was to provide an overview of the key results and recommendations derived from the interviews conducted. With regard to the research questions and the information gathered from observations and interviews, the researcher presented and discussed the results of the qualitative study. The results are summarised and recommendations are given in the following chapter.

CHAPTER FIVE:

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In Chapter Four, the research methodology and pertinent ethical considerations were discussed in relation to the data collection, analysis, and interpretation. The chapter included a discussion on the data collection and theme identification and processes. The research recommendations from the findings are discussed in detail in this chapter, with a focus on the information obtained from the interviews.

5.2 Summary of Chapter One

Chapter One introduced the background to the research, the problem statement, the study's objectives and research questions, and broad ideas surrounding Society 5.0. While the systems that control the supply of electricity and other utilities to our homes operate with computerised automated controls, they operate under a limited scope of functionality, brought on by several factors, namely legacy systems, cybersecurity concerns, cost constraints, integration complexity, reliability and redundancy, human oversight, data and communication limitation, and skill shortage. In reference to Society 5.0, information systems must collect data, process it, and apply the results in a real-world environment but in a more integrated manner, and at a more granular level (Deguchi et al., 2020). Given the problem narrative, the main research objective was to investigate the digital capabilities required by the private utility environment to participate and remain competitive in Society 5.0. In addressing the main objective, the main research question was to determine the digital capabilities of a South African private utility to participate and compete in Society 5.0.

5.3 Summary of Chapter Two

This section used existing literature to frame the problem by identifying gaps to be explored. In Chapter Two of the literature review, a strong theoretical base was established for the study emphasising how digital infrastructure plays a role in reshaping the utility sector to align with Society 5.0 principles. The chapter delved into technologies and their possible advantages while also discussing the obstacles and environmental factors linked to their application. This examination offered insights into the status of digital infrastructure and its forthcoming possibilities, laying the groundwork for the empirical research and analysis showcased in later chapters.

5.4 Summary of Chapter Three

Chapter Three provided specifics on the methods used to collect the data needed to answer the study's research questions. This chapter included a discussion of the research paradigm and techniques that were applied to the study. The research design was then explained in depth, together with information on the sample size and target demographic sampling strategy used in this investigation. This section included comments on the reliability and rigour of the data collecting process tools as well as insights into them. The summary and concluding remarks clarified the ethical principles that were used during the investigation.

5.5 Summary of Chapter Four

At the beginning of the section, the research topic and related questions were restated. After that, the staff's comments were reviewed to determine the response rate, background information about the respondents, and any potential biases resulting from non-response. The results and analysis followed in the next section of the chapter.

5.6 Summary of Chapter Five

The study's findings are summarised in Chapter Five, which draws firm conclusions regarding the crucial role that digital infrastructure will play in setting private utility firms up for success in Society 5.0. The suggestions provide helpful advice for resolving issues and utilising digital technology to attain competitiveness and sustainability over the long run. Private utility firms can improve consumer satisfaction, increase operational efficiency, and help to ensure a more sustainable energy future by implementing these suggestions.

5.7. Revisiting the objectives

5.7.1 Explore the digital infrastructure required for a private utility to benefit fully from Society 5.0

The data collected identified that significant investments are needed in advanced digital technologies, and that financial and technological constraints are major barriers to adoption. The study identified key technologies driving the transformation in the private utility sector, such as IoT, AI, and Big Data analytics. Real-time monitoring, proactive maintenance, and efficient resource allocation are made possible by these technologies. Participants highlighted the importance of integrating these technologies to improve efficiency and sustainability. In order to increase sustainability and efficiency, participants emphasised how crucial it is to integrate these technologies. The goal of the study was achieved by offering practical suggestions that would direct investment in and strategic planning for digital infrastructure, as well as addressing environmental challenges associated with digital infrastructure, highlighting the importance of sustainable practices.

5.7.2 Determine the type of skills required for the workforce of a private utility to support a super smart society

The critical need for continuous upskilling and the role of organisational leadership in fostering a culture of learning and development was emphasised. Adaptability, data analytics, cybersecurity, and digital literacy are among the necessary competencies. The workforce's development of these abilities depends on leadership support and ongoing upskilling. One important finding was the requirement for a workforce equipped with new skills and capabilities. The need for specialists with knowledge of digital tools, cybersecurity, and data analytics is rising as the industry develops was stressed. To prepare the next generation, participants underlined the importance of upskilling current workers and supporting STEM education.

5.8 Drawing conclusions from research findings

5.8.1 Experience and skill development

Participants alluded to the fact that experienced individuals play a role in adapting to advancements but that it is also important to prioritise upskilling and training efforts to meet the changing requirements of 4IR and 5IR technologies. Organisations need to invest in workforce development programmes to enhance their capabilities and to stay adaptable.

5.8.2 Challenges in technology adoption

Some of the participants pointed out that financial constraints, technological limitations, and environmental concerns present significant barriers to the adoption of smart grid technologies and other innovations. Overcoming these challenges requires strategic investments, stakeholder collaboration, and sustainable practices to facilitate the transition to a smarter and more resilient infrastructure.

5.8.3 Vision and leadership

Participants expressed their views on effective communication of the company's vision, coupled with dedicated leadership. A focus on education, training and skill enhancement plays a role in promoting preparedness and cohesion within the workforce. It is imperative for leaders to involve employees in the transition phase and to offer the assistance and tools to ensure smooth execution.

5.8.4 Knowledge gaps

Participants' limited grasp of the 4IR and 5IR highlights the significance of raising awareness and promoting efforts to change this. Fostering literacy and encouraging learning are crucial, in empowering employees to adapt to technological progress and to foster organisational development.

5.9. Recommendations

These recommendations are drawn from the conclusions derived from the findings and their implications for private utility companies.

- An important factor and the foundation of all strategies to be implemented by an organisation if they are striving towards participating in Society 5.0, administrative strategy entails planning, organising, controlling, and all other activities that will enhance their readiness. To start with, the organisation must declare their goal and all stakeholders involved must be informed about the move to get them prepared.
- Awareness campaigns should include the end users to bring them up to speed with the staff servicing them. Another important aspect is a thorough assessment of the current situation in comparison to the standards that are necessary for Society 5.0.
- It was suggested that the company should consider setting up important subject-specific training sessions to equip the staff and get them ready for the work ahead.
- Considering the line of business, a private utility company must ensure adequate technical strategy that will propel and leave them with strong competitive advantage against their competitors. Assessing the strategies they have adopted so far, findings showed that they are projecting to the future already even when they are still using the old technologies.

5.10 Research limitations and future research

The study was conducted at a private utility organisation in the Western Cape. The initial sample size was 50 participants, but only 15 were available for interviews, resulting in a low response rate. The quantity and representativeness of the data are limited by the small sample size. It is possible that the conclusions cannot be applied to the private utility sector in other parts of South Africa. Response bias is another drawback, since workers may have reacted in different ways depending on their experiences or perceptions, which affects and influences the outcomes.

Each interview session was planned for a duration of 60 minutes. Semi-structured interviews were selected to enable thorough examination of participants' perspectives while preserving a certain degree of uniformity throughout the interviews. The semi-structured format ensured that all essential topics were addressed while allowing for some flexibility. The interviews were carefully converted into written transcripts to guarantee the reliability and accuracy of the information. Transcribed data were systematically analysed to identify common themes and insights relevant to the research objectives. Care was taken in managing the data ensuring to protect the confidentiality and security of participant information during the analysis phase.

A careful analysis of the real shifts in the workplace is required, in addition to the expectations and opinions of important parties about how Society 5.0 and the 4IR would affect the private utility sector. With the uptake and reliance of organisations of all sizes and types on digital technology, more research is required to explore the post-adoption influences on the skills required. The projection of all participants indicates that renewable energy is an energy production source that needs to be explored further.

5.11 Chapter summary

This chapter articulated the main discoveries of this study that were emphasised. It presented a framework that considered technology and individual variables within the context of feedback from participants and responses to the research questions. The research study's contributions and limitations were underscored along with recommendations for future research endeavours.

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APPENDICES

Appendix 1: Ethics clearance

Cape Peninsula
University of Technology

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South Africa
Tel: +27 21 4603291
Email: fbmsethics@cput.ac.za

Office of the Chairperson Research Ethics Committee	FACULTY: BUSINESS AND MANAGEMENT SCIENCES

The Faculty's Research Ethics Committee (FREC) on 3 May 2022, ethics APPROVAL was granted to **Trudy Abrahams (206246781)** for a research activity at the Cape Peninsula University of Technology for **M Tech: Business Administration.**

Title of project:	**Exploring the digital capabilities of a private utility for Society 5.0 at a selected organisation in the Western Cape** Researcher (s): Ms L Harker

Decision: APPROVED

Signed: Chairperson: Research Ethics Committee	**12 May 2022** **Date**

The proposed research may now commence with the provisions that:

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

Clearance Certificate No | 2022 FBMSREC 018

Appendix 2: Ethics Guidelines

Cape Peninsula University of Technology

FACULTY RESEARCH ETHICS COMMITTEE
Business and Management Sciences Faculty
Ethical Considerations Questionnaire (REC 5)

Type of research project/activity [Tick One Box with "X"]

	Staff Project	X	Postgraduate Project (Masters and Doctoral level)		Undergraduate Project (e.g., Diploma and B Tech level)

Title of Project	Exploring the digital capabilities of private utilities for Society 5.0.
Name of researcher(s)	Trudy Abrahams
Name of Supervisor(s) (if appropriate)	Lee-Anne Harker

Type of the study [Tick One Box with "X"]

	Ethnography		Interview		Focus group discussion		Document based
X	Case study		Deception		Others specify:		

Describe the sampling design by selecting whatever is applicable to the study

X	Purposive sampling		Convenient sampling		Theoretical sampling
	Probability sampling		Mixed Methods sampling		Descriptive
	Interim Analysis		Multi-center study		Other specify:

		YES	NO	N/A
1	Will you describe the main experimental procedures to participants in advance, so that they are informed about what to expect?	X		
2.	Will you tell participants that their participation is voluntary?	X		
3.	Will you obtain written consent for participation?	X		
4.	If the research is observational, will you ask participants for their consent to being observed?			X
5.	Will you tell participants that they may withdraw from the research at any time and for any reason?	X		
6.	With questionnaires will you give participants the option of omitting questions they do not want to answer?	X		
7.	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	X		
8.	Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?	X		

Faculty of Business and Management Sciences Ethics Committee: 2020 v01 Template 1

Cape Peninsula University of Technology

FACULTY RESEARCH ETHICS COMMITTEE
Business and Management Sciences Faculty
Ethical Considerations Questionnaire (REC 5)

Type of research project/activity [Tick One Box with "X"]

	Staff Project	X	Postgraduate Project (Masters and Doctoral level)		Undergraduate Project (e.g., Diploma and B Tech level)

Title of Project	Exploring the digital capabilities of private utilities for Society 5.0.
Name of researcher(s)	Trudy Abrahams
Name of Supervisor(s) (if appropriate)	Lee-Anne Harker

Type of the study **[Tick One Box with "X"]**

	Ethnography		Interview		Focus group discussion		Document based
X	Case study		Deception		Others specify:		

Describe the sampling design by selecting whatever is applicable to the study

X	Purposive sampling		Convenient sampling		Theoretical sampling
	Probability sampling		Mixed Methods sampling		Descriptive
	Interim Analysis		Multi-center study		Other specify:

		YES	NO	N/A
1	Will you describe the main experimental procedures to participants in advance, so that they are informed about what to expect?	X		
2.	Will you tell participants that their participation is voluntary?	X		
3.	Will you obtain written consent for participation?	X		
4.	If the research is observational, will you ask participants for their consent to being observed?			X
5.	Will you tell participants that they may withdraw from the research at any time and for any reason?	X		
6.	With questionnaires will you give participants the option of omitting questions they do not want to answer?	X		
7.	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	X		
8.	Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?	X		

Cape Peninsula University of Technology

FACULTY RESEARCH ETHICS COMMITTEE
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Ethical Considerations Questionnaire (REC 5)

Type of research project/activity [Tick One Box with "X"]

	Staff Project	X	Postgraduate Project (Masters and Doctoral level)		Undergraduate Project (e.g., Diploma and B Tech level)

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	Ethnography		Interview		Focus group discussion		Document based
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Describe the sampling design by selecting whatever is applicable to the study

X	Purposive sampling		Convenient sampling		Theoretical sampling
	Probability sampling		Mixed Methods sampling		Descriptive
	Interim Analysis		Multi-center study		Other specify:

		YES	NO	N/A
1	Will you describe the main experimental procedures to participants in advance, so that they are informed about what to expect?	X		
2.	Will you tell participants that their participation is voluntary?	X		
3.	Will you obtain written consent for participation?	X		
4.	If the research is observational, will you ask participants for their consent to being observed?			X
5.	Will you tell participants that they may withdraw from the research at any time and for any reason?	X		
6.	With questionnaires will you give participants the option of omitting questions they do not want to answer?	X		
7.	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	X		
8.	Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?	X		

Appendix 3: Informed consent and questionnaire

Faculty of Business and Management Sciences
Ethics Informed Consent Form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Category of Participants (tick as appropriate):

Staff/Workers	**X**	*Teachers*		*Parents*		*Lecturers*		*Students*	
Other (specify)									

You are kindly invited to participate in a research study being conducted by Trudy Abrahams from the Cape Peninsula University of Technology. The findings of this study will contribute towards (tick as appropriate):

An undergraduate project		*A conference paper*	
An Honours project		*A published journal article*	
A Masters/doctoral thesis	**X**	*A published report*	

Selection criteria

You were selected as a possible participant in this study because you are:

(a) An employee of Private Utility organisation

(b) Permanently employed with more than 1 year relevant working experience.

(c) Contractually employment with at least 3 months working experience within the organisation preferably with previous relevant experience within the Private Utility Industry.

(d) Work within the Management Team, IT, Customer Solutions Centre, Solutions Technical Centre, Finance Department, Project Office or Operational Support.

The information below gives details about the study to help you decide whether you would want to participate.

Title of the research:

Exploring the digital capabilities of private utilities for Society 5.0.

A brief explanation of what the research involves:

This study aims to explore the digital capabilities required by the private utility environment to participate and remain competitive in within Society 5.0. Primary data will be generated through conducting face-to-face interviews with Private Utility management and employees.

Appendix 4: Editing certificate

Ricky Woods Academic Editing Services

Editing Certificate

Ricky Woods Academic Editing Services
Cell: +27 (0)83 3126310
Email: rickywoods604@gmail.com

To Whom It May Concern

Cape Peninsula University of Technology

Editing of a Master's Dissertation

I, Marietjie Alfreda Woods, hereby certify that I have completed the editing and correction of the dissertation: **Exploring the Digital Capabilities of a Private Utility for Society 5.0 at a Selected Organisation in the Western Cape by Trudy Abrahams** in partial fufilment of the requirements for the degree **Master of Technology: Business Administration.** I believe that the dissertation meets with the grammatical and linguistic requirements for a document of this nature. The following aspects were covered in the process of the editing:

- A full language edit was completed, including grammar, spelling, concord, clumsy expression;
- Reference formatting was checked according to the Harvard style stipulated by CPUT;
- Heading styles were standardised;
- Formatting was checked;
- Table of Contents and Lists of Figures and Tables were checked.

Name of Editor: Marietjie Alfreda Woods

Qualifications: BA (Hons) (Wits); Copy-editing and Proofreading (UCT); Editing Principles and Practice (UP); Accredited Text Editor (English) (PEG)

MA (Ricky) Woods

13 June 2024

Ricky Woods
Full Member
Accredited Text Editor (English)

Appendix 5: Turnitin report