



A deeper look at the advent of the Fourth Industrial Revolution (4IR) and what it means for the marginalized, a Social Innovation perspective.

By

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DECLARATION

I, Sihle Maphukatha (Student Number 3366722) declare that the study titled, A deeper look at the advent of the Fourth Industrial Revolution (4IR) and what it means for the marginalized, a Social Innovation perspective, is my own work, that it has never been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated, acknowledged and correctly referenced.

Sihle Maphukatha

Signed: ... 

Date: ...15/11/2023.....



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DEDICATION

I dedicate this study to myself. This dedication serves as a tribute to the resilience and perseverance I have shown throughout the research period and in life generally. Through every setback and triumph, I have evolved, and this study stands as a testament to my capacity for continuous improvement.

This study is the reminder of the challenges I conquered, the lessons I learned, and the knowledge I gained.

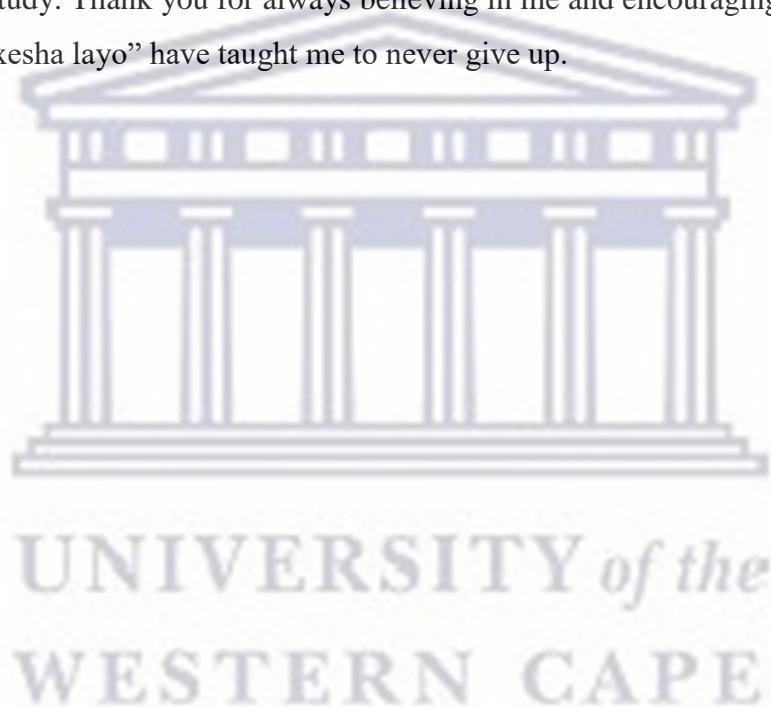


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Abstract

The current technological paradigm shift known as the Fourth Industrial Revolution (4IR), has impacted all parts of the world including the African continent. Developing countries such as South Africa are preparing for the transformative technological changes brought by 4IR. According to Schwab and other scholars 4IR is the fourth major industrial era since the 18th century in which new technologies are fused together with the physical, digital, and biological worlds affecting all disciplines, economies, and industries. South Africa recognizes the potential of adopting 4IR technologies to address issues of poverty, unemployment, and inequality. However, currently South Africa lacks the necessary resources, skills, and infrastructure to fully utilize the opportunities and mitigate the risks associated with these technologies, particularly in the marginalized society.

This study seeks to determine the effect of the 4IR on the marginalized society and explore possible roles that can be played by social innovation (SI) to mitigate possible challenges and ensure inclusive participation in the implementation of the current technological revolution. SI is defined as new ideas such as products, services, and models that equally meet social needs and create new social relationships or collaborations that aim to develop society. In the context of this study, marginalized society refers to the demotion of society due to a lack of access to rights, resources, and opportunities.

The study adopted a case study approach and a qualitative method of data collection, through literature review and case study analysis. The study analyses the case study of Zenzeleni Networks with an objective to analyze the participation of the marginalized groups in the technological space, as the country is preparing to adopt the new technological transformation. The findings of the study present an e analysis of the impact of the Zenzeleni Networks project in Mankosi Village. The analysis highlights the tangible improvements experienced by the marginalized individuals, resulting from their active engagement with SI and the adoption of 4IR technologies. Zenzeleni Networks is a community-owned and operated telecommunications network, which originate from one of the marginalized villages of Mankosi, in the Eastern Cape Province, Nyandeni Local Municipality in South Africa.

Keywords

Fourth Industrial Revolution(4IR),

4IR policy.

High skilled.

Low Skilled.

Marginalized Society.

Policy framework

Social Innovation (SI).

South African Government.

Technological era.

Technological transformation.

Unemployment.

ABBREVIATIONS AND ACRONYMS

CA: Capability Approach

4IR: Fourth Industrial Revolution

ICT: Information and communications technology

IoT: Internet of things

IT: Information Technology

IR: Industrial Revolution

ISP: Internet Service Provider

SA: South Africa

SI: Social Innovation

DSI: Department of Science and Innovation

ZN: Zenzeleni Networks

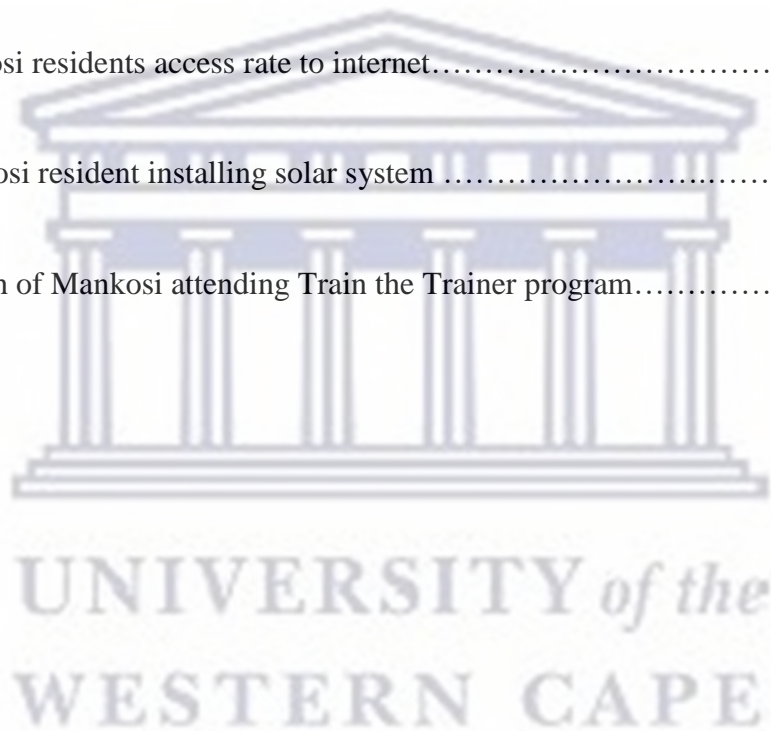
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CHAPTER ONE: INTRODUCTION

1.1 Introduction and background

The Fourth Industrial Revolution (4IR) is rapidly changing societies around the world, bringing both challenges and opportunities across various sectors (Schwab, 2016). Developing countries like South Africa, are at a crucial stage in embracing this wave of technological advancements. According to Schwab (2016), 4IR involves the fusion of technologies that blur the boundaries between the physical, digital, and biological domains, transforming our way of life, work, and interaction. South Africa recognizes the opportunity to adopt the 4IR technologies to address societal issues such as poverty, unemployment, and inequality, as highlighted by Mahmood and Mubarik (2020). However, the country currently lacks the necessary resources, skills, and infrastructure to fully utilize these opportunities and mitigate the associated risks, especially in marginalized communities (Naudé, 2017).

This study takes a deeper look at the advent of the 4IR in South Africa, particularly in marginalized societies, from a social innovation perspective. It explores the opportunities and challenges presented by 4IR and emphasizes the role of social innovation in mitigating the potential challenges. Social innovation, as defined by Murray and colleagues (2010), refers to new ideas such as products, services, and models that meet social needs and foster new social relationships or collaborations to benefit society. In the context of this study, marginalized society refers to those who are disadvantaged due to limited access to rights, resources, and opportunities (Schwab, 2016).

The study analyses the case study of Zenzeleni Networks with an objective to analyze the participation of the marginalized groups in the technological space, as the country is preparing to adopt the new technological transformation. The findings of the study present an analysis of the impact of the Zenzeleni Networks project in Mankosi Village. The analysis highlights the tangible improvements experienced by the marginalized individuals, resulting from their active engagement with SI and the adoption of 4IR technologies. Zenzeleni Networks is a community-owned and operated telecommunications network, which originate from one of the marginalized villages of Mankosi, in the Eastern Cape Province, Nyandeni Local Municipality in South Africa. Mahmood and Mubarik (2020) contend that the advent of the Fourth Industrial Revolution (4IR) is all-encompassing and inclusive in its approach to addressing global challenges through intelligent systems, in contrast to prior industrial revolutions that primarily

focused on mass production, transportation, rapid electricity utilization, and communication technology. However, this assertion may not hold true in the context of South Africa, where there exists a shortage of skills and challenges associated with inadequate infrastructure to support the ongoing transformation. According to Naudé (2017), the introduction of this technological shift has generated apprehension and uncertainty within marginalized communities. Echoing Naudé (2017), scholars such as Sutherland argue that the poor and unskilled individuals will confront even more pronounced disadvantages with the advent of the digital era.

Moreover, South Africa contends with a substantial skills deficit stemming from deficiencies in its education system, impeding the supply of essential managers, researchers, and workers required for the Fourth Industrial Revolution (4IR). Sutherland (2020) further asserts that inadequate infrastructure quality and governance weaknesses exacerbate the uncertainties surrounding the embrace of 4IR technologies in the country.

To capitalize on the opportunities offered by the 4IR, Brynjolfsson and McAfee (2014) emphasize the importance of recognizing its impact on society as a whole and considering social innovation alongside technological advancements. Buhr (2017) acknowledges the significant impact of social innovation at the system level, highlighting the interrelationship between technical and social innovation. This study reviews existing literature on the intersection of 4IR and marginalized societies, with a focus on the impact of technological disruptions on socioeconomic structures and the potential for exclusion. It explores how marginalized communities face unique barriers in accessing and benefiting from the opportunities brought by 4IR. These barriers include limited access to technology, inadequate digital literacy, and systemic inequalities.

Consequently, this study aims to explore the societal dimensions of the Fourth Industrial Revolution (4IR), illustrating how the interplay between technology and social innovation can effectively tackle contemporary societal challenges. Criticism has been directed at past industrial revolutions and their corresponding policies for their inability to adequately confront urgent issues like climate change, chronic diseases, and inequality (Weyer et al., 2015). Ultimately, this study focuses on determining the effects of 4IR on marginalized communities and the role social innovation can play in ensuring their inclusive participation in this technological era.

1.2 Rationale of the study

The rationale of this study lies in the need to understand the implications of the 4IR on marginalized societies in SA and the role of social innovation in addressing the challenges and promoting inclusive participation. As highlighted by Schwab (2016) South Africa recognizes the potential of 4IR technologies to address persistent challenges of poverty, unemployment, and inequality. However, the country faces limitations in terms of resources, skills, and infrastructure, particularly in marginalized societies. This study aims to explore how social innovation can mitigate these challenges and unlock opportunities for inclusive development. Overall, this study's rationale lies in the urgency to understand the impact of 4IR on marginalized societies in SA and the potential of social innovation to mitigate challenges and promote inclusive participation. By shedding light on these issues, the study aims to inform decision-making processes and contribute to the development of strategies that harness the benefits of technological advancements for the betterment of all members of society. The study is significant because it seeks to highlight the importance of integrating SI policies with 4IR policies in the process of implementing new technological systems that are of benefit to the poor and marginalized. The study focuses on the participation of the marginalized group in the implementation of the 4IR through SI policies in South Africa.

1.3 Problem Statement of the study

South Africa, as a developing nation, is facing the challenges and opportunities presented by the Fourth Industrial Revolution (4IR). While 4IR technologies have the potential to address issues of poverty, unemployment, and inequality, marginalized societies in South Africa are at risk of being left behind due to limited resources, skills, and infrastructure (Brynjolfsson and McAfee, 2014). Additionally, as Oosthuizen (2016) alluded, there are unique challenges faced by marginalized communities, including limited access to technology, inadequate digital literacy, and systemic inequalities. The problem is that the marginalized societies in South Africa lack the necessary resources and support to fully utilize the opportunities and mitigate the risks associated with 4IR technologies. Without addressing these challenges, there is a significant risk of worsening the existing challenges and leaving marginalized communities further marginalized in the digital era (Buhr, 2017).

Furthermore, there is a gap in the literature regarding the specific impact of 4IR on marginalized societies in South Africa and the role of social innovation in addressing these

challenges. Existing studies often focus on broader implications of 4IR without considering the specific needs and barriers faced by marginalized communities (Shcwab, 2017).

By addressing this problem, the research aims to offer valuable insights and recommendations that can inform policies, strategies, and interventions to ensure that marginalized communities are not left behind in the transformative era of 4IR. The results obtained from this study are expected to provide valuable insight into the decision-makers or policymakers in South Africa, focusing on identifying ways to equip marginalized societies for the implementation of the 4IR. The study is also expected to help guide research and the development of new innovative systems in underdeveloped communities.

1.4 Aims and Objectives of the study

This study aims to determine the effect of the Fourth Industrial Revolution on the marginalized and explore possible roles that can be played by social innovation in ensuring inclusive participation in the implementation of the current technological revolution. The aims and objectives of the study is to analyze the participation of the marginalized group in the technological space and highlight the essence of social innovation in integrating new technological developments and mitigate possible challenges, the study is also guided by the following sub objectives:

- Identify the benefits of implementing the 4IR in South Africa.
- Explore roles that can be played by SI in 4IR implementation.
- Take a deeper look at different policy framework that focuses on the implementation of 4IR in South Africa
- Explore how can community participation in the technological space be enhanced to ensure that the benefits of the 4IR are realized by all?

1.5 Chapter Outline

This section provides brief outline about all chapters in this research. The research consists of 6 chapters as follow:

Chapter 1: Introduction, gives an overview of our thesis, our study area, research objectives, research question, and the empirical basis of this study.

Chapter 2: Literature and theoretical concepts, intends to go through relevant literature where the first subchapter introduces 4IR and provides brief background about the technological transformation. The next subsection introduces the concept of social innovation and use case study and relevant literature to explore the social innovation principles in promoting mass participation in the technological transformation. Finally, the study provides an overview on the role of social innovation in the advent of the 4IR in South Africa.

Chapter 3: Methodology & paradigms, this chapter gives an understanding of all the methods have been used for conducting the research. It provides information on the adopted case study as the example of social innovation impact in preparing the marginalized.

Chapter 4: This chapter provides findings gathered from the case study and relevant literature review to unpack the study research questions.

Chapter 5: Analysis and discussion, this chapter provides an analysis and discussion of the findings gathered.

Chapter 6: Conclusion and Recommendations, this chapter provides the overall outcomes of the study and highlight future recommendations based on the case study analysis and the findings collected. The chapter further highlights future work to be done and limitations within the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Schwab (2016) asserts that technological advancements are progressively reshaping the way individuals and organizations function. The current era, known as the Fourth Industrial Revolution, is characterized by swift and unpredictable transformations in technology, economy, politics, and society (Oke and Fernandes, 2020). According to Schwab (2016), this ongoing technological shift involves the integration of physical, digital, and biological realms, with the potential to disrupt society, business, and government through innovative breakthroughs. Dhaou (2019) suggests that this revolution presents new opportunities capable of transforming developing countries and aligning them with developed markets through the adoption of emerging technologies. Governments, including that of South Africa, are leveraging this digital-driven industrial revolution to enhance social and economic inclusion, steering toward a smart society (Naudé, 2017).

Nevertheless, the emergence of the 4IR in SA brings both significant social and economic prospects and challenges, necessitating appropriate governmental responses to support societal transformation (Manda and Dhaou, 2019). Morry (2017) proposes that social innovation can serve as a crucial element in addressing challenges posed by the 4IR in South Africa, particularly within marginalized communities. As defined in the preceding chapter, this study considers marginalized society as social exclusion, where individuals or groups face demotion due to limited access to rights, resources, and opportunities, with a specific focus on the low-skilled marginalized society. Naudé (2017) characterizes SI as novel practices employed to tackle social challenges, with a positive impact on individuals, society, and organizations. In essence, SI entails the development of new models, services, and products that concurrently address social needs.

This section focuses on reviewing relevant literature and discusses the theoretical background of the 4IR and SI. The section also highlights the components of the 4IR, along with SI principles identified from reviewed literature and the interaction between 4IR and SI in general. The section also explores different policy frameworks that influence the implementation of the 4IR in South Africa and provide an outlook on South African reality during the advent of the technological transformation 4IR. Lastly, the chapter reflects on the proposed a proposed framework for the advent of 4IR through SI in South Africa.

2.2 Overview of the 4IR

This section provides a concise overview of the historical progression of industrial revolutions, commencing with the first industrial revolution and progressing to the current fourth industrial revolution. It aims to provide a clearer understanding of the ongoing technological transformation by presenting an overview of the 4IR.

The industrial revolution (IR) generally denotes a period marked by technological advancements leading to significant and profound changes in the socioeconomic landscape of individuals and nations (Olaitan et al., 2021). Olaitan and colleagues (2021) emphasize that the global economy has experienced three major IRs before the current revolution. The first industrial revolution occurred from 1760 to 1840, characterized by the invention of steam locomotive power, revolutionizing textile industries in England and other developed nations. The second industrial revolution transpired from the late 19th century to the early 20th century, marked by the development of electricity, mass production, and the division of labor. The third industrial revolution began in the early 1950s with the advancement of electronics, information technology (IT), and automated production. The global economy is currently traversing the initial phases of the fourth industrial revolution a term believed to have been first mentioned in the 1940s.

Schwab (2016) defines 4IR as the fourth major industrial era since the 18th century, characterized by new technologies that integrate the physical, digital, and biological worlds, impacting all disciplines, economies, and industries. In alignment with Schwab (2016), Sutherland (2020) describes 4IR as the ongoing technological transformation building upon the third revolution the digital revolution that has unfolded since the twentieth century. Weyer (2015) adds that 4IR signifies the evolution from automated and computer-controlled manufacturing facilities (3rd IR) to more advanced facilities capable of autonomously gathering and analyzing data to make intelligent decisions. This new technological transformation is seen as a shift toward decentralized production, departing from the centralized production of previous revolutions (Vitor, 2014).

However, some scholars, including Vitor (2014), depict 4IR as a new wave of the technological revolution that poses threats to human existence, disrupts labor markets, and contributes to escalating income inequalities and unemployment, especially in developing countries. Naudé (2017) further notes that the advent of 4IR and its consequences has instilled fear, particularly

in many developing economies, due to its impact on job dislocations, skill instabilities, existing rising unemployment, and skill shortages, all of which are already undermining economic transformation and sustained growth.

Mahmood (2020) concludes that the 4IR is a broad and fast current technological era with its description that varies from department to department. Consequently, this study is guided by Schwab's (2015) definition, which defines 4IR as the technological transformation that has the potential to enhance people's skills and upgrade the standard of living equally, mostly in developing countries.

2.3. Key Components of the 4IR

The successful integration of the Fourth Industrial Revolution (4IR) hinges on the commitment of governments, businesses, and citizens to foster the transformation of society into a modern and intelligent entity propelled by advanced technology, skills, innovation, and adaptive policy frameworks (Neumeier, 2017). This section underscores several crucial elements of 4IR, with the key components encompassing Information and Communication Infrastructure, Emerging Technologies, Education and Training, Innovation, and Policy Innovation.

2.3.1. Information and Communication Infrastructure and Emerging Technologies

Information and Communications Technology (ICT) is defined as the infrastructure and components that facilitate modern computing, as noted by Abdelnour (2013). Buhr (2017) extends this definition, encompassing all devices, networking components, applications, and integrated systems that enable interactions in the digital realm for individuals and various organizations, including businesses, nonprofit agencies, governments, and even criminal enterprises. Technology, identified by Abdelnour (2013) as a significant driver of the 4IR, involves key advancements such as cloud computing, the Internet of Things (IoT) with the development of smart products, and the Internet of Services (IoS) like smart mobility and coordination, including the Internet of Energy for efficient resource utilization.

Buhr (2017) underscores the necessity for establishing a comprehensive and reliable industrial broadband infrastructure. Telecommunication technologies and infrastructures, including broadband and other internet technologies, are crucial, according to Buhr (2017), for providing digital connectivity essential for effective communication, collaboration, and the integration of people, systems, and machines. Schwab (2016) reinforces this perspective, highlighting the

stringent requirements imposed by 4IR on communication networks, demanding reliability, comprehensiveness, and high quality. In alignment with Schwab (2016), Van Rensburg et al. (2019) emphasize that the integration and interoperability of cyber-physical systems are pivotal for enhancing communication and collaboration between humans and machines in the 4IR.

The core of the 4IR lies in cyber-physical systems that control and monitor various systems and processes, utilizing advanced ICTs such as robotics, sensors, and advanced manufacturing techniques like additive manufacturing (Oosthuizen, 2016). Schwab (2018) concurs, asserting that Cyber-Physical Systems play a significant role in integrating the real physical world with the virtual world for future development. Another key feature highlighted by Schwab (2018) is the use of big data to enhance efficiency and decision-making in the context of the Fourth Industrial Revolution.

2.3.2. Education and training

The emergence of the Fourth Industrial Revolution is anticipated to bring about disruptive changes in the labor market, with a significant increase in the demand for highly skilled labor (Mahmood & Mubarik, 2020). Schwab (2018) emphasizes that the ongoing digital transformation and innovation in the context of 4IR necessitate a workforce comprised of highly skilled and technologically oriented individuals. This has prompted a recognition of the need to prioritize the development of future skills, particularly in developing countries like South Africa, where some essential skills are currently lacking, and a substantial portion of the population relies on low-skilled jobs.

The onset of 4IR introduces both challenges and opportunities that call for human intelligence and skills. Schwab (2016) suggests that 4IR has the potential to replace humans with automation and reduce physical human interaction. Creative work processes, such as strategic planning, research, and development, are expected to drive demand for skills required to identify, conceptualize, and implement new and innovative opportunities presented by Industry 4IR (Lekhanya, 2019). Anticipating and preparing for future skills requirements, understanding job content, and assessing the overall impact on employment are becoming increasingly crucial for businesses, governments, and individuals to fully capitalize on the opportunities presented by these trends and address potential negative outcomes (World Economic Forum, 2019). However, the effects on work and employment are projected to be complex, potentially exacerbating inequality by reducing the demand for low-skilled jobs.

Lekhanya (2019) asserts that South Africa faces a significant skills shortage, attributed to shortcomings in its education system. Furthermore, higher education institutions in rural South Africa encounter challenges such as poor reading and literacy skills, deficient reasoning and logic skills, and limited utilization of technology assets. These challenges highlight the visible imbalance and inadequacy within the South African education system's skill development. Additionally, concerns persist that technology, particularly through automation in 4IR, has the potential to replace humans (Adendorff et al., 2018).

2.3.3. Innovation

McKinsey (2015) posits that the Fourth Industrial Revolution (4IR) necessitates the development of innovative products, business models, and production techniques driven by technology. This demands increased investment in research and development by countries. OSIKA (2019), based on a study conducted in Switzerland, highlights the growing importance of research and development as a catalyst for innovation in the 4IR. Additionally, a global study by McKinney (2015) underscores that for South Africa to evolve into a globally competitive hub, there is a need for the sector to enhance its innovation capabilities, particularly within marginalized communities, ensuring inclusive participation in the onset of 4IR through Social Innovation.

Schwab (2017) underscores the importance of sustainability and inclusive growth through strategies that ensure the benefits of digital transformation contribute to society and address human and developmental challenges. This aspect becomes particularly crucial in developing countries facing human and social challenges, necessitating governments to devise innovative approaches to address these issues. The emphasis on social innovation is highlighted as a key factor in navigating the complexities of the Fourth Industrial Revolution.

2.3.4. Policy innovation

Neumeier (2017) contends that innovative policy and legislative reforms play a crucial role in supporting digital transformation. These reforms enable governments to enact measures and allocate resources to address the challenges and opportunities presented by the digital era. Innovations within the Fourth Industrial Revolution (4IR) are anticipated to introduce new challenges, including reduced demand for low-skilled labor, enterprise data security concerns, liability issues, and privacy concerns related to personal data. These challenges necessitate stringent regulation through standards, legislation, and policies (Maynard, 2015). Schwab

(2018) emphasizes the pivotal role of policy structures in governing the intricacies of the smart environment and ensuring equitable benefits.

Maynard (2015) emphasizes that developing countries aspiring to adopt the 4IR need to formulate an industrial policy specifically tailored to guide the country through the transformation. This policy should address issues related to skills, infrastructure, funding, and regulation. Adendorff and colleagues (2018) argue that a well-structured policy environment creates a conducive atmosphere for the success of smart industries. Governments are expected to develop responsive economic, industrial, and labor market policies to better prepare industries, citizens, and society for the opportunities presented by the current technological era. Equal adoption of the current digital era hinges on the effectiveness of government-imposed policy structures and strategies. These strategies should provide clear guidelines on how governments can appropriately respond to the demands of the digital, connected, and smart environment (Adendorff et al., 2018). Manda and Dhaou (2019) suggest that the challenge lies not in the absence of strategies but rather in the failure of strategies to align with the local context. The literature review indicates that the discussed drivers of the Fourth Industrial Revolution (4IR) serve as key pillars for ensuring inclusive implementation and realizing the benefits of this transformation equitably.

2.4 The Advent of 4IR: A South African Reality

South Africa has recently embarked on the journey of the Fourth Industrial Revolution marking a departure from previous revolutions in terms of its speed, scale, complexity, and transformative power, as noted by Schwab (2016). As industrial revolutions evolved from the mechanization of production in the first to mass production in the second, and subsequently to the automation of production in the third, the living standards of people worldwide experienced significant and dramatic improvements (Mukwawaya et al., 2018). Manda and Dhaou (2019) assert that the latest industrial revolution holds the potential to advance technology, but the completion of this sentence seems to be missing. If you have specific content you'd like me to include, please provide more information. has the potential to make even bigger and greater improvements in every aspect of life than the first three industrial revolutions combined. On the other hand, there are several challenges to overcome because of the 4IR. This section looks at the South African reality during the advent of the 4IR.

The benefits brought by the 4IR in South Africa are accompanied by challenges that require mitigation and resolutions. These challenges include income inequality, poor infrastructure, access to higher education and a shortage of skilled workers, as pointed out by Neumeier (2017). According to Vitor (2014), technological advancements drive global transformations that impact societies, institutions, and economies. Furthermore, Manda and Dhaou (2019) highlight how technological transformations influence various aspects of people's lives, work, and social interactions. Prisecaru (2016) emphasizes the importance of comprehending these new technologies and their potential for disruption, particularly for developing countries like South Africa.

Prisecaru (2016) asserts that the Fourth Industrial Revolution (4IR) brings about a range of effects on society and the economy, encompassing both negative and positive aspects. Buhr (2017) notes that a substantial portion of the global population utilizes social media platforms for connectivity, learning, and information sharing. Furthermore, various innovative producers and competitors have easy access to digital marketing, sales, and distribution platforms, enhancing the quality and affordability of goods and services.

However, the arrival of the current technological transformation generates uncertainty, particularly among marginalized societies and low-skilled individuals, as it appears to exacerbate inequality and lead to the displacement of low-skilled jobs (OSIKA, 2019). The challenges posed by the Fourth Industrial Revolution are not exclusive to developing countries; developed nations also grapple with its complexities (Manda and Dhaou, 2019). According to Van Rensburg and colleagues (2019), Europe faces challenges such as the need for investment, evolving business models, data issues, legal questions related to liability and intellectual property, standards, and skills mismatches. Additionally, they highlight that in Germany, societal challenges including job loss, disqualification, new forms of stress, and increased social insecurity have surged with the onset of 4IR. The section below discusses some of the challenges faced by South Africa during the advent of the 4IR. The challenges include job loss, Skills shortage, inadequate infrastructure, and Security and privacy.

2.4.1. Potential Job Losses

The increased integration of technology in the Fourth Industrial Revolution (4IR) has raised concerns about significant job losses, particularly among low-skilled workers (Ayentimi and Burgess, 2019). The World Economic Forum (2016) acknowledges that the major drivers of transformation affecting global industries are expected to have varied impacts on jobs, ranging from substantial job creation to displacement, and from increased labor productivity to widening skills gaps. In developing countries like South Africa, these concerns are heightened by the existing struggle to reduce high unemployment rates. South Africa, with a severe unemployment rate of 45% according to national accounts data (Statistics South Africa, 2021), is particularly vulnerable to the potential negative effects on employment.

2.4.2. Skills Shortage

Skills, innovation systems, and knowledge communities play a crucial role in providing the intellectual guidance necessary for the development and implementation of smart and digital initiatives (Todaro and Smith, 2011). Hlatshwayo (2019) identifies e-skills and e-literacy as fundamental to the success of a smart society, highlighting challenges such as skills mismatches and skills redundancy due to the evolving nature of jobs in the face of technological advances. Additionally, Sutherland (2020) emphasizes that e-literacy and e-skills influence citizens' ability to fully participate in social and economic activities in a smart society. The low level of digital platform skills in developing countries like South Africa is identified as a challenge in the transformation toward smart societies.

2.4.3. Infrastructure Challenges

Developing countries face not only societal challenges but also technological and infrastructure challenges in the Fourth Industrial Revolution (4IR) (Schwab, 2018). Poor Information and Communication Technology infrastructure (ICT) in these countries poses a significant obstacle to governments in implementing 4IR initiatives (Oosthuizen, 2016). In South Africa, poor broadband penetration is a major barrier delaying the transition to a smart society driven by digital connectivity, advanced technology, skills, knowledge, and innovation (Oke & Fernandes, 2020).

2.4.4. Security and Privacy

Security and data privacy concerns have become significant issues in the Fourth Industrial Revolution (4IR), where technology serves as a key driver (Waidner & Kasper, 2016). The integration of systems in the 4IR necessitates the development of new security and protection mechanisms for collaborative value networks and smart production systems (Oke and Fernandes, 2020). Adendorff and colleagues (2018) anticipate that increased use of data analytics will bring new challenges regarding data privacy and protection. Moreover, privacy and security concerns in technology introduce trust issues in the technological era (Manda & Backhouse, 2016).

Responding to Challenges and Opportunities in the 4IR in Developing Countries. Researchers argue that the 4IR differs from previous industrial revolutions in the speed with which technological progress replaces lower-skilled workers with higher-skilled workers (Naudé, 2017). Schwab (2016) raises the challenging concern of whether South Africa will be able to fully participate in 4IR activities due to a lack of necessary skill sets. Ogwo (2018) adds that low investment in education and training, along with emerging skill shortages in key sectors across the country, may further hinder South Africa's ability to fully engage in the 4IR.

According to Arnaldo (2017) 4IR has the potential to enable sustainable prosperity by utilizing modern technologies to find solutions to challenges related to energy, resources, the environment, and social and economic impacts. Adendorff (2018), believes that integrating Social Innovation and 4IR may be a better way to ensure that the marginalized acquire the necessary skills to keep up with this drastic transformation and that equal participation in the technological space is realized.

2.5. Fourth Industrial Revolution: A Policy Framework in South Africa

As South Africa navigates the onset of the Fourth Industrial Revolution (4IR), this section explores the role of government policies in the realms of social innovation, education, and skill development. According to Gleason (2018), the formulation of innovative policy and legislative reforms is crucial in facilitating digital transformation. These reforms empower the government to enact measures and allocate resources in response to the challenges and opportunities presented by the new technological era. The advent of the 4IR introduces novel challenges, including trade restrictions, enterprise data security, liability issues, and personal

data privacy. Schwab (2017) emphasizes that addressing these challenges requires stringent regulation through the establishment of standards, legislation, and policies. The complexity of the smart environment, shaped by 4IR innovations, necessitates a robust policy structure to govern its intricacies (Mukwawaya et al., 2018). In this context, the South African government's policies will play a pivotal role in shaping the trajectory of the 4IR. Effective policy frameworks can guide the country in capitalizing on the opportunities presented by digital transformation while mitigating potential risks. As the 4IR unfolds, policymakers in South Africa must actively engage with social innovation, education, and skill development to foster a responsive and inclusive approach to technological advancements.

The 4IR is a disruptive revolution that requires adequate preparation before implementation. George (2018) specified at the International Conference on Industrial Engineering and Operations Management in Johannesburg that South Africa's policy framework is not positioned to drive 4IR and a holistic strategy that includes government policy on innovation, education, and skills development is required. The power of this dramatic technological innovation has the potential to propel digitally prepared countries into a new era of success. However, inconsistencies in policy and regulatory failures in key enabler areas, such as the telecommunications and energy sectors, have a negative impact on South Africa's readiness for more widespread 4IR adoption (Schwab 2016).

Manda and Dhaou (2019) emphasize the necessity of government-led policies and strategies to address the challenges and opportunities presented by the digital transformation in the Fourth Industrial Revolution (4IR). They argue that effective policy development and implementation are fundamental to ensuring that the benefits and challenges of 4IR are realized by all sectors of society. Despite the recognized importance of policy development, the challenge lies in the execution of these reforms, as poor policy implementation has been observed. Over the years, the South African government has made efforts to develop regulatory mechanisms addressing certain challenges of 4IR, particularly those related to security and privacy (Buhr, 2017). However, the successful implementation of these reforms remains a challenge.

Collaboration among various sectors is identified as a key factor in ensuring the success of the ongoing technological transformation brought about by 4IR, affecting not only businesses but also governments and society (Neumeier, 2017). Maynard (2015) stresses that responsive policies and strategies aligned with South Africa's priorities require the government to

collaborate with businesses and social partners. The collaborative effort is seen as essential for addressing challenges and leveraging opportunities presented by 4IR.

Addressing the anticipated job losses in unskilled job categories due to the introduction of robotics in advanced manufacturing is another critical aspect. Adendorff and colleagues (2018) suggest that integrating government, businesses, workers, and labor unions is necessary to formulate strategies that mitigate the risk of massive job losses, preventing further deepening of unemployment, poverty, and inequalities. Van Rensburg and colleagues (2019) highlight the importance of addressing the current social, political, and economic challenges that have led to mistrust and weakened cohesion. They note that self-interest and corruption in the development and implementation of policy reforms can be significant setbacks in South Africa, particularly affecting marginalized societies. Overcoming these challenges is crucial for effective policy implementation and achieving inclusive benefits from the 4IR.

The primary objective of this study is to examine how social innovation (SI) can enhance the effectiveness of the 4IR. Therefore, it is crucial to explore into the concept of SI and its implications for collective enterprise. In the context of South Africa, particularly in marginalized communities, this study suggests that a social innovation framework can serve as a key element in addressing the challenges presented by the 4IR. According to Neumeier (2017) the successful adoption of the 4IR hinges upon the commitment of governments, businesses, and citizens to facilitate societal transformation, leveraging advanced technology, skills, innovation, and responsive policy to build a modern and intelligent society.

To comprehend the process of SI and its potential to mitigate 4IR challenges, the next section outlines the proposed framework by Benneworth (2017).

2.6 Overview on Social Innovation

The concept of Social Innovation (SI) has emerged as a framework aiming to capture and describe a bottom-up approach. In this approach, new ideas, methodologies, techniques, and organizational forms originate from grassroots initiatives, contributing to practical new social capacities that drive social change and development (Juliani et al., 2017). Moulart (2013) positions SI as a pioneering theme in the study of innovation, emphasizing its evolving nature and the varied descriptions within the research field. The term is commonly used in literature but lacks consistent usage, leading to diverse conceptual overlays and discussions among

scholars and practitioners. Elliott (2013) notes the diverse definitions encompassed within SI, which exhibit several conceptual overlays. Two comparable definitions are presented by Murray and colleagues (2010), defining SI as new ideas, such as products, services, and models, that simultaneously address social needs and foster new social relationships. This points to innovations that not only benefit society but also enhance its capacity to act. Bacon and colleagues (2008) similarly characterize social innovation as the development of new ideas tailored to meet social needs.

The widespread use of the term "social innovation" has resulted in various meanings and concepts, contributing to different understandings. However, this study aligns with Mahmood & Mubarik's (2020) definition, framing SI as an innovative solution to the growing challenges in society. This solution is characterized by being more effective, efficient, sustainable, and equitable than existing practices. This comprehensive definition serves as a guiding perspective for the exploration of Social Innovation in the context of the Fourth Industrial Revolution in the subsequent discussions.

2.7 Social Innovation processes

As per Bepa (2014), Social Innovation (SI) has gained considerable momentum as it provides avenues to address contexts marked by significant crises, where traditional approaches fall short in offering adequate solutions to pressing problems or new challenges faced by society. Schwab (2017) emphasizes that SI should not be narrowly perceived solely as activities aimed at solving social problems, such as social exclusion, poverty, well-being deficits, unemployment, and underdevelopment. Instead, it should be seen as a process rooted in actions developed by collaborative networks through bottom-up initiatives, whether intentional or arising organically from a process of social change without prior planning.

In this light, social innovation assumes a central role in social change processes that strike a balance between values of equality and solidarity and economic considerations. It contributes to fostering social inclusion and sustainable development. As a dynamic process, SI not only addresses immediate challenges but also acts as a catalyst for broader societal transformation, emphasizing the interconnectedness of social, economic, and collaborative dimensions.

Benneworth and Cunha (2015) describe SI as a socially innovative practice that delivers social outcomes by developing innovative solutions in border-spanning learning communities

by creating social value through community development promotion. Simple means that SI also forms wider collaborative networks, and challenges existing social institutions through collaborative actions. Benneworth (2015) further mentioned that for an initiative practice or action to be considered as SI, it should focus on reducing inequality, promoting quality of life, and achieving inclusive societies. This means that the role of SI in the advent of 4IR is to promote quality of life and reduce inequality in an inclusive society.

This study is guided by the double-loop SI model, as proposed by Benneworth and Cunha (2015) to understand the SI processes, and how SI can be used to champion 4IR challenges and ensure that the 4IR benefits are being realized by everyone. The proposed framework consists of six process stages, as described by Benneworth and Cunha (2015). The six phases encompass: (1) Prompts, which entail recognizing the existing need. (2) Proposals, involve formulating a novel idea as a remedy to the recognized challenges. (3) Prototyping, signifies the phase where ideas are put into practical tests or implementation. (4) Sustaining pertains to devising a model to guarantee the enduring viability of new practices and innovations. (5) Scaling involves devising strategies for the expansion and dissemination of Social Innovation (SI). (6) Systemic transformation, wherein the aim of any SI initiative is to effect change on a broader scale.

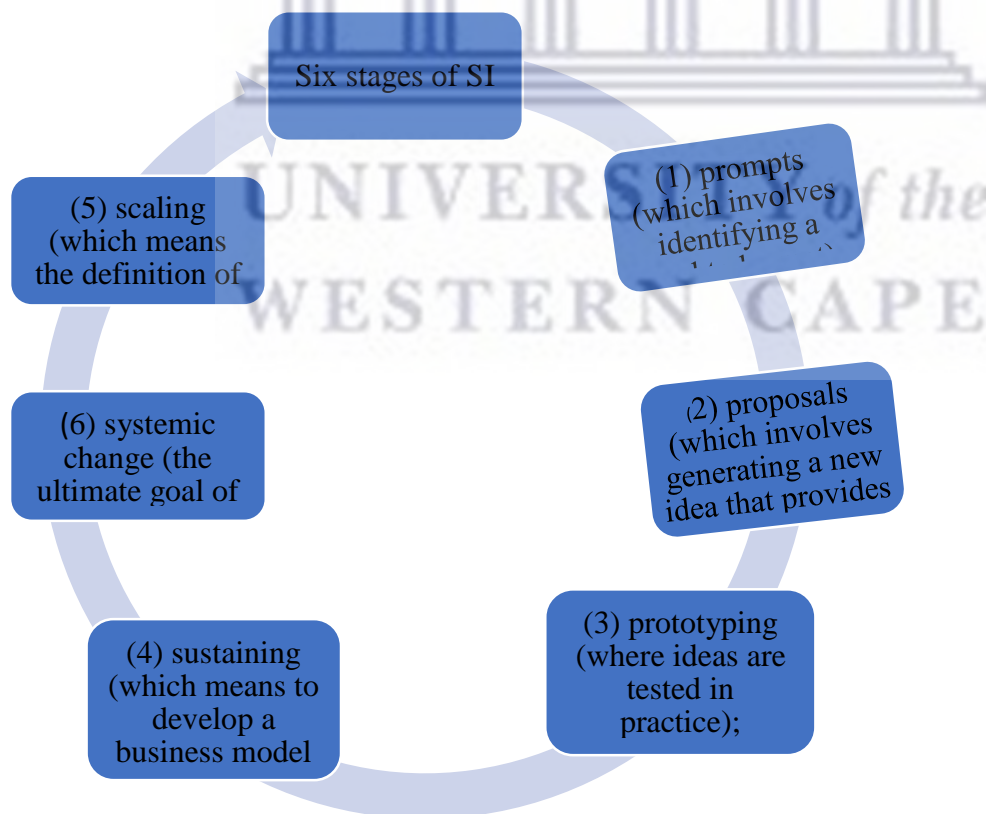


Figure1: Social Innovation conceptual framework model (Benneworth et al., 2015)

The presented model follows a double-loop structure, with the initial loop constituting a cycle wherein a singular demonstrator is developed through a process involving the first stage. In this cycle, the idea generation phase entails devising a solution for a previously identified social issue. Subsequently, the implementation stage focuses on meeting the societal needs to support promising and potential innovations. According to Benneworth (2015), the concluding stage of the first loop showcases the innovations and the transformative impact on society. The second loop in the framework proposed by Benneworth and Cunha (2015) is centered on upscaling the social innovation beyond its original location. This phase concentrates on identifying methods to expand the innovative solution and deliver broader societal benefits. The framework advocates for inclusive support, leveraging networks to unite institutions and aid in the upscaling process. This implies that with the integration of current technological transformations, social innovation holds the potential to yield societal benefits on a larger scale, ensuring that these advantages are accessible to everyone. In this proposed framework, social innovation emerges as a product that can be readily implemented in numerous new settings, locations, or circumstances, facilitating its upscaling.

This section looked at the double loop SI framework model by Benneworth and Cunha's (2015) to understand the SI processes, and how SI can be used to champion 4IR challenges and ensure that the 4IR benefits are being realized by everyone. The integration of this SI framework with the 4IR is expected to offer functionalities that could contribute productively to the societal inclusivity.

2.8 Fourth Industrial Revolution through Social Innovation in South Africa

According to Osika (2019), Social Innovation is the process and factors leading to sustained positive transformation in society's development. It is defined as an innovative solution that is more effective, efficient, sustainable, or equitable in addressing societal challenges than existing practices (Neumeier, 2017). Schwab (2018) asserts that Social Innovation is a key tool to overcome challenges posed by the Fourth Industrial Revolution (4IR), reshaping community functioning and establishing new relationships and structures holistically (Schwab, 2016). Neumeier (2017) emphasizes the core of these changes is better alignment with the current needs of society, from local to global solutions, with the primary objective of improving the quality of life for all members of society.

This section delves into the implementation of the Fourth Industrial Revolution (4IR) through Social Innovation in South Africa. The advent of 4IR brings significant opportunities and challenges, necessitating appropriate government responses to support societal transformation (Schwab, 2016). While technology's power is rapidly increasing and fostering innovation globally, it does not inherently guarantee an open, diverse, and inclusive global society (Schwab, 2016). Drawing lessons from past industrial revolutions, this study focuses on marginalized societies in the South African context, utilizing the capability approach and a socio-technical perspective. The capability approach, as outlined by Sen (1999), emphasizes what individuals can effectively do and be based on their capabilities, functions, and agency. Sen's approach considers various aspects of life, including survival, health, work, education, relationships, empowerment, self-expression, and culture, as integral to evaluating living standards (Robeyns, 2005).

Capability, as defined by Sen (1999), is the freedom to engage in various functions, combining functioning with opportunity freedom. The Capability Approach, coupled with the Socio-Technical Perspective, enables a holistic policy approach to align with the Fourth Industrial Revolution (4IR). Understanding the implications of digital transformation on skills, jobs, work systems, and society at large is crucial for preparing governments and citizens for the digital-driven revolution (Oke et al., 2020). The proposed strategic framework, based on Schwab's (2017) description of South Africa's 4IR, emphasizes the need for commitment from government, businesses, and citizens to support the transformation towards a modern and smart society driven by advanced technology, skills, innovation, and responsive policy.

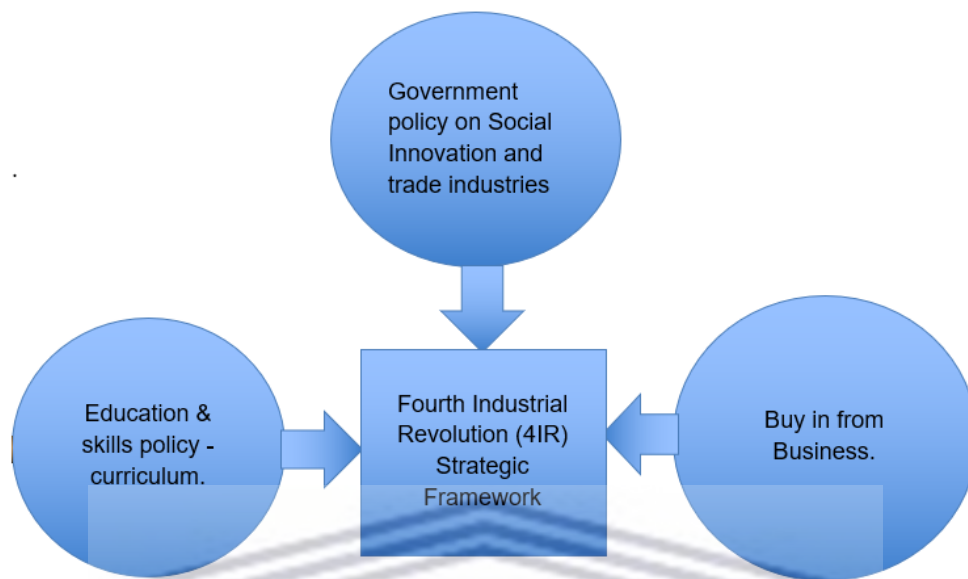


Figure 2: Fourth Industrial Revolution proposed a strategic plan framework. (Schwab, 2016)

Mahmood and Mubarik (2020) define social innovation as the set of processes and factors leading to a sustained positive transformation in the network society. It is described as an innovative solution to the increasing challenges faced by society, aiming for more effective, efficient, sustainable, and equitable outcomes compared to current practices (Conference, 2019). Gleason (2018) emphasizes that social innovation involves both novelty and improved responses to societal needs. However, Adendorff (2018) highlights that the challenge lies not in the absence of strategies but in the failure of strategies to align with the local context, resulting in poorly conceptualized approaches.

2.9 Chapter Summary

In summary, the reviewed literature emphasizes the importance of leadership from all sectors working collaboratively for the success of the Fourth Industrial Revolution (4IR) in South Africa. Social innovation is identified as a key player in preparing society for the transformative changes brought about by the new technological era. OSIKA (2019) concludes that the South African government should acknowledge the 4IR and its potential to address the country's triple challenges of poverty, unemployment, and inequality. It is recommended that developing countries create context-specific models and strategies instead of adopting approaches that have worked in different contexts. Strategies should prioritize social benefits over economic prospects, addressing challenges such as potential job losses, wage gaps, and skills redundancy. The government should demonstrate how social innovations within the 4IR can effectively tackle societal challenges and enhance the overall quality of life and social well-being.



CHAPTER THREE: Research Design and Methodology

3.1 Introduction

Research methodology is a structured inquiry process designed to acquire in-depth knowledge about a particular subject. Its primary goals include the discovery and generation of new knowledge, as well as the construction or testing of theories through the examination, confirmation, revision, or challenging of existing knowledge (Hofisi et al., 2014). A robust research methodology is crucial for guiding the researcher in achieving research objectives with scientific rigor, ensuring systematic planning, and adhering to scientific standards to yield reliable results. According to Nel and Schoeman (2015), a research project should follow an established research methodology. This entails the development of processes, tools, and procedures to collect evidence and effectively analyze the identified problem. In the context of this study, a case study approach and a qualitative research method were adopted. Data was gathered through a comprehensive literature review and case study analysis.

The study analyses the case study of Zenzeleni Networks with an objective to analyze the participation of the marginalized groups in the technological space, as the country is preparing to adopt the new technological transformation. Zenzeleni Networks is a community-owned and operated telecommunications network, which originate from one of the marginalized villages in South Africa

This chapter describes the methodology used in conducting the research. The chapter first provides a brief case study theory building, followed by the research design and setting adopted for the study. The chapter further describes the data collection, data source/sample, sampling techniques, data processing, analysis, and presentation used to generate data for this study. This chapter also includes an explanation regarding the ethical considerations and trustworthiness of the research study undertaken. The chapter concludes with study limitations.

3.2. Case study as theory building

For this study, the researcher adopted an exploratory research design employing a case study approach. According to Yin (2009) case studies are used to investigate, describe, or explore events or phenomena within their natural contexts. The research strategy involves utilizing one or more cases to generate theoretical constructs, propositions, and midrange theories based on empirical evidence from the cases (Eisenhardt 1989). Case studies involve the in-depth

examination of specific instances of a phenomenon, utilizing diverse data sources (Yin, 1994). Yin (2009) defines a case study as an empirical inquiry that delves deeply into a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and its context are not clearly defined. The case study approach is deemed appropriate for research involving multiple variables of interest, diverse data sources, and the application of pre-existing theoretical propositions (Yin, 2009). Benbasat (2017) asserts that case study research, with its focus on in-depth analysis, is particularly well-suited for theory building in areas with limited prior research and a poor understanding of the subject. Eisenhardt (1989) provides guidance on developing theory through case studies, outlining steps for conducting qualitative research and illustrating how these steps can contribute to the formulation of new theoretical propositions.

This study adopted an exploratory approach to analyze the advent of the 4IR on marginalized societies in South Africa and the potential role of SI to mitigate possible challenges brought by the 4IR. The research strategy aims to develop a theoretical understanding of how 4IR influences marginalized communities and the potential contributions of SI to mitigate challenges brought by the 4IR.

3.3 Research Design and Setting

A research design indicates how the research is set up, what happens to the subjects, and what methods of data collection are used (Nel and Schoeman, 2015). This study adopted a case study approach with the aim to determine the effect of 4IR in the marginalized society and explore possible roles that can be played by social innovation to prepare marginalized society for the new technological transformation. The research approach employed in this study is qualitative, exploratory, and descriptive, utilizing a case study methodology built on secondary data. Zenzeleni Networks serves as the selected case study, originating from Mankosi village in Nyandeni municipality, South Africa.

As outlined by Green and Tull (2019), a research design is the plan specifying methods and procedures for gathering necessary information, providing a structured strategy to address research questions and control variance (Kerlinga, 2018). In alignment with Kothari (2004), research design serves as a tool aiding the researcher in addressing research questions logically and convincingly. It is a logical structure for data collection, offering guidance on the sequence and methodology of data collection throughout the research process.

This study used a case study approach with the aim to gain more understanding of the research problem through various literature and government policy documents.

3.4. Data Collection

This research was based on secondary data, literature review, and raw data from the government database and relevant stakeholder databases were used to understand the different 4IR policies, and approaches used in South Africa, mostly in the marginalized society, and how other countries have prepared for the advent of the 4IR. Journal articles, books, websites, policy papers, reports, work papers, and other relevant sources were reviewed to derive the information. Tull (2019) believes that using secondary data helps in finding different forms of inquiry and applying an appropriate theoretical or conceptual framework that will relate new findings to former findings.

3.5 Data processing, analysis, and presentation

Procedures for data analysis, as outlined by Gibbs (2018), serve as tools for exploring, investigating, and explaining information already collected to address research objectives and questions, condensing data into various themes and patterns. Thematic analysis, a qualitative research method, was employed in this study, following the approach described by Braun and colleagues (2022). Thematic analysis involves identifying, analyzing, organizing, describing, and reporting themes within a data set to determine the study's outcomes (Sharma, 2018). Case studies relevant to the research were extracted from the literature, and the selected case study is further detailed in the subsequent chapter.

Pattern matching, suggested by Yin (2009) as a preferred strategy for case studies, was utilized in this study. Creswell (2009) emphasizes the significance of a data analysis plan in providing categories of information to establish emergent themes. The data analysis for this case study involves interpreting qualitative data collected from multiple sources, including literature review and the case study, with the goal of uncovering patterns, themes, and trends related to the impact of the Fourth Industrial Revolution on marginalized societies in South Africa and the role of Social Innovation in addressing these challenges.

Data analysis process for this case provides a robust understanding of the impact of 4IR on marginalized societies in South Africa and the role of social innovation to mitigate possible

challenges brought by the 4IR. The analysis further offers a valuable insight into the challenges faced by marginalized communities, the opportunities for inclusive participation, and the potential strategies for leveraging SI to address the identified issues.

3.6 Ethical considerations

Cresswell (2014) emphasizes that research often involves interaction with people, and throughout the research process, participants may be affected either positively or negatively. This underscores the need for the entire research process to adhere to high ethical standards to protect respondents from harm. Ethical norms and procedures are crucial to ensuring that results and findings are credible and trustworthy, preventing misconduct, and promoting research integrity. For this study, a research proposal was submitted to the Institute for Social Development, the Economic and Management Sciences Higher Degrees Committee, and the Senate Higher Degrees Committee. The study received approval from the Humanities and Social Sciences Research Ethics Committee (HSSREC) of the University of the Western Cape. Ethical clearance was granted with ethical number HS21/10/12, and the study was conducted in adherence to ethical guidelines. To maintain academic honesty, the researcher has acknowledged all materials used in this study with a complete list of references.

3.7 Limitations of the Study

The limitations of the study include contextual specificity, scope, and generalizability. The study focuses on the South African context, and the findings may not be directly transferable to other countries or regions. The unique socio-economic, political, and cultural factors in South Africa may influence the dynamics of the impact of 4IR on marginalized societies and the effectiveness of SI. Furthermore, the study focus on marginalized societies in South Africa may limit the generalizability of the findings to other populations or contexts. The specific challenges, opportunities, and dynamics of 4IR and SI in South Africa may differ from those in other countries or regions.

3.8 Chapter Summary

This chapter offered an overview of the methods utilized in the study, emphasizing the predominantly qualitative nature of the research. The research is characterized as qualitative, exploratory, and descriptive, relying on a case study approach built on secondary data. Data collection involved a literature review and the examination of relevant secondary materials, including government documents and policies. The study also adhered to ethical considerations, and some encountered limitations were outlined. Below are examples of case studies that delve into social innovation and the Fourth Industrial Revolution in marginalized communities:

Zenzeleni Networks Case Study: Zenzeleni Networks, originating from Mankosi village in Nyandeni municipality, serves as a community-owned and operated telecommunications network in South Africa. This case study explores how Zenzeleni Networks embodies social innovation within a marginalized community, addressing connectivity challenges and fostering local empowerment.

South African Education System Case Study: Investigating the impact of the Fourth Industrial Revolution on the South African education system serves as another case study. This could involve an examination of policies, initiatives, and innovative approaches implemented to equip students with the necessary skills for the digital era, especially in marginalized regions.

Government Social Innovation Policies: A case study focusing on government policies related to social innovation in South Africa could provide insights into how regulatory frameworks are designed to promote inclusive development in the face of the Fourth Industrial Revolution. This would involve an analysis of specific policies, their implementation, and their impact on marginalized communities.

Impact of 4IR on Employment in Marginalized Areas: This case study could explore the effects of the Fourth Industrial Revolution on employment patterns in marginalized areas. It might involve assessing how technological advancements, automation, and digital transformation impact job opportunities and skills development in these communities.

Community Empowerment through 4IR:

Examining how marginalized communities actively engage with the Fourth Industrial Revolution for their empowerment could be a compelling case study. This would involve assessing local initiatives, collaborative efforts, and innovative solutions that leverage digital technologies to address social challenges. Each of these case studies has the potential to provide valuable insights into the intersection of social innovation, the Fourth Industrial Revolution, and marginalized communities in South Africa



CHAPTER FOUR: RESULTS

4.1. Introduction

This study aims to examine the impact of the Fourth Industrial Revolution (4IR) on marginalized communities and explore the potential roles that social innovation (SI) can play in ensuring inclusive participation in the implementation of this technological revolution. To achieve this, the study adopts a comprehensive approach that combines a literature review with empirical evidence extracted from relevant case studies.

Among the case studies examined, Zenzeleni Communication Network emerged as a noteworthy example of how SI can effectively harness the potential of the 4IR to bridge the digital divide and empower marginalized communities. Zenzeleni Networks, a community-owned and operated telecommunications network in South Africa, exemplifies the transformative power of SI in addressing the challenges posed by the 4IR.

By focusing on the Zenzeleni Networks case study, this chapter delves into the intricacies of the project and examines how it provided technological solutions to marginalized communities through SI. The study seeks to unpack the mechanisms through which Zenzeleni Networks addressed the specific challenges faced by these communities, thereby mitigating the negative consequences of the 4IR.

The literature review conducted in this study underscores the importance of adopting a holistic approach to leverage the opportunities and address the challenges of the 4IR in South Africa. The success of the 4IR hinges upon the collaboration and co-creation among businesses, government entities, communities, and civil society. This collaborative effort is essential for achieving social impact and ensuring that the benefits of the 4IR are distributed equitably.

Moreover, the literature emphasizes the significance of a bottom-up approach that involves the active participation of marginalized communities in decision-making processes. By engaging these communities and incorporating their perspectives, SI can foster inclusive participation in the current technological transformation. This bottom-up approach acknowledges the unique needs, aspirations, and capabilities of marginalized communities, enabling them to become active contributors and beneficiaries of the 4IR.

4.2 Case study: Zenzeleni Networks Project

Locating Zenzeleni Networks

Zenzeleni Networks operates within the complex socio-economic landscape of the Eastern Cape province in South Africa. The region's development is shaped by a multifaceted interplay of political, economic, legislative, environmental, and social factors that operate at different levels, ranging from local to international. Despite progress since the end of apartheid, the Eastern Cape grapples with substantial disparities among its various regions. While some areas of the province have experienced economic growth and benefited from government initiatives, a significant portion of the population still faces poverty and high unemployment rates. As of 2017, a staggering 72% of the Eastern Cape's population lived below the poverty line, highlighting the persistent challenges in uplifting disadvantaged communities (Takavarasha et al., 2018).

Despite being the third-largest province in South Africa in terms of population, the Eastern Cape is categorized as one of the poorer provinces, underscoring the significant socio-economic hurdles that persist in the region (Takavarasha et al., 2018). These challenges create a complex backdrop for initiatives like Zenzeleni Networks, emphasizing the need for innovative solutions to address the unique socio-economic dynamics of the Eastern Cape. Health issues also pose a major concern in the Eastern Cape, with a high prevalence of HIV among the population. The province's HIV prevalence rate, standing at 29%, is among the highest in the country, placing additional strain on the region's healthcare system and overall development (DSI, 2022).

Given these circumstances, it is evident that Zenzeleni Networks operates in an environment with complex social and economic challenges. To make a meaningful impact, the networks needed to consider ways to address these issues while providing its products or services, especially in regions that have been historically marginalized or underserved. Collaborating with local communities, NGOs, and government initiatives could be crucial to creating sustainable solutions and positive change.

4.3 Biographical statistics of Mankosi

Zenzeleni Networks is situated in ward 26 of the Nyandeni municipality, which is recognized as one of the impoverished districts within the Eastern Cape. This classification is based on various poverty indicators. According to official records from Statistics South Africa, the Mankosi area consists of 564 households spread across 12 villages. Within these households, families typically comprise up to five adults and seven children, resulting in an average household size of 6.02 individuals (Stats SA, 2021). Consequently, Mankosi is estimated to have a local population of approximately 3,395 people, with 2,070 individuals (60.9%) aged 15 years or older. Moreover, the majority of the residents in this area are female, accounting for 70.6% of the total population (Stats SA, 2021).

The aforementioned data aligns with the statistics provided by Statistics South Africa (2022) for the Nyandeni local municipality. To illustrate these figures, a visual representation is presented below, depicting the population of Mankosi along with their living conditions. Additionally, the statistics pertaining to the number of young individuals pursuing higher education are highlighted in the image.

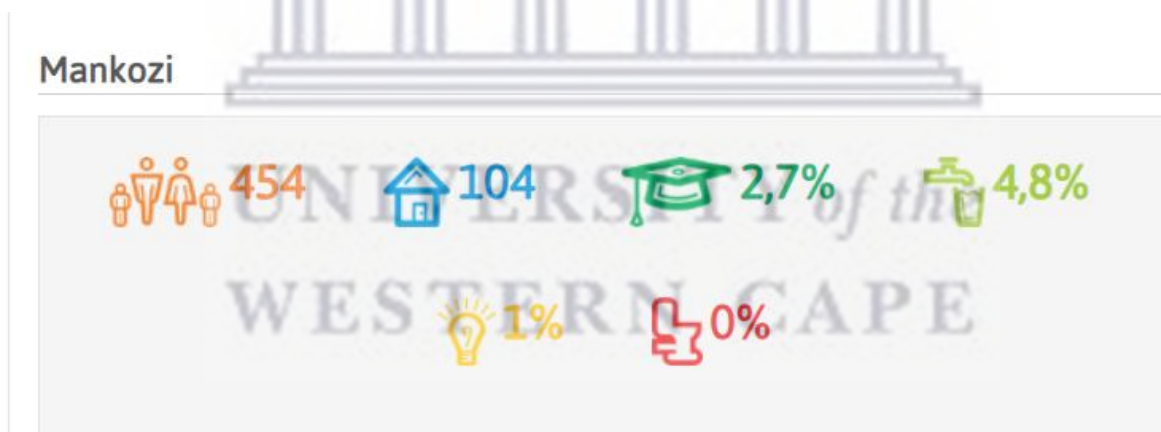


Figure 3: Mankosi population statistics

Source: Stats SA (2022)

The local municipality statistics suggest a gender distribution of 56.82%, with a higher proportion of men residing and working in urban areas, and many registered men seeking temporary work outside Mankosi, which contributes to this gender distribution discrepancy (Rey-Moreno, 2015).

Rey-Moreno (2015) provides additional insights into household statistics, noting that the government initiated the construction of pit latrines in all households in 2013. Rainwater collection using flat-roofed housing is more common among affluent individuals, while communal water points remain the primary water source for many residents. A prevalent practice involves women carrying buckets on their heads, with 95.4% of households adopting this method. Cooking practices often rely on open fires fueled by wood from nearby indigenous forests, as gas or paraffin is only occasionally affordable for most families. Regarding electricity infrastructure, 84% of households lack electrical lighting, with only 2.1% connected to the grid, and a mere 13.5% equipped with some form of generator, solar, or gas infrastructure (Rey-Moreno, 2015).

As per Stats SA (2020), the Mankosi village is classified as one of the impoverished villages in the Eastern Cape province.

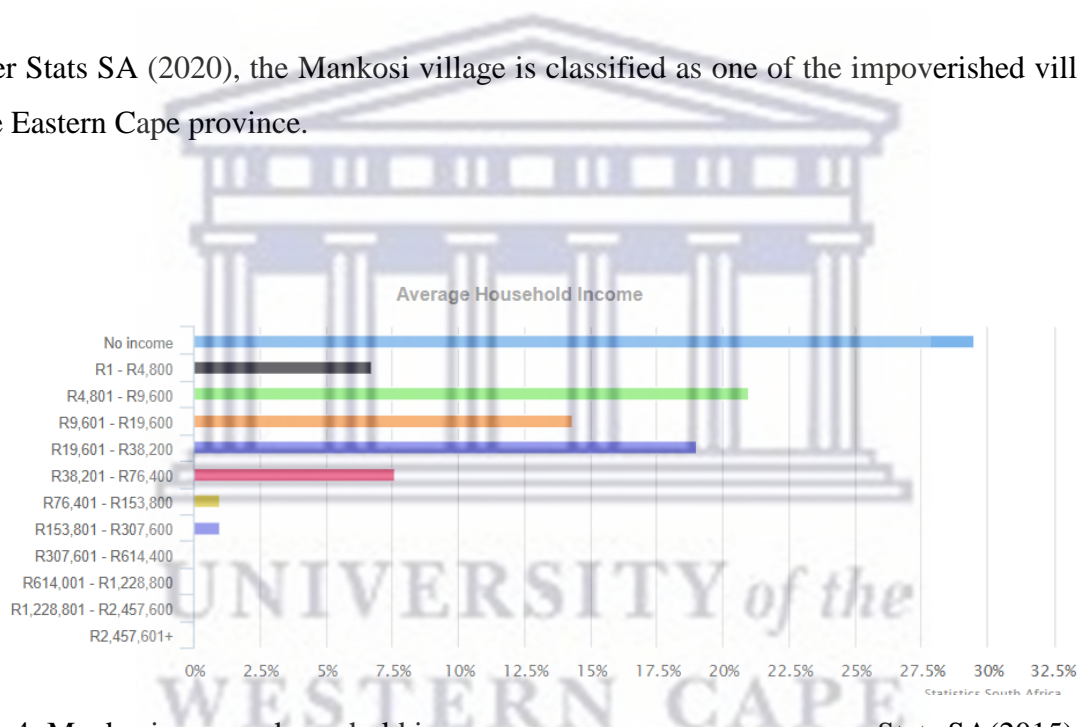


Figure4: Mankosi average household income Stats SA(2015)

The graph provided depicts the average household income in Mankosi village, revealing a reported monthly household income of R1,831.00. This income is predominantly sourced from government grants and remittances from family members engaged in temporary work migration. Consequently, the reported individual monthly income in Mankosi is R388.00, implying that individuals in the village subsist on approximately US\$1 per day. This income is primarily used to settle accrued credit at the local shop, with few households having savings. Approximately 58.6% of households report not having a bank account (Rey-Moreno, 2015).

This contrasts significantly with the average monthly individual income of R2,587.00 for the country as a whole. Given the pronounced inequality levels in South Africa and the average disposable income at the local municipality level, it is expected that many other rural communities will exhibit disposable income levels comparable to those observed in Mankosi.

4.4 Zenzeleni Networks Project at Mankosi: A Social Innovation Model

Zenzeleni Networks represents a social innovation initiative, characterized as a grassroots and community-driven socio-technical and economic endeavor. Its primary objective is to establish an open and neutral telecommunications network based on a shared model (DSI, 2020). Through community networks, historically marginalized communities, especially those in rural areas, gain access to the technical skills and knowledge needed to install and manage their own electronic communications infrastructure. This social innovation empowers rural communities by providing ownership of their telecommunication businesses, enabling them to maximize the benefits and value derived from such initiatives.

The inception of Zenzeleni Networks dates back to 2012 when a doctoral student from UWC (University of the Western Cape) engaged in action research in the area and collaborated with a local community activist. The initiative subsequently formed a partnership between UWC and the local tribal authority of the Mankosi community. Over six years, the project underwent collaborative development and creation, garnering local buy-in and support. The name "Zenzeleni" reflects the initiative's ethos, translating to "Do it yourselves," emphasizing the community's active role in driving their own progress.

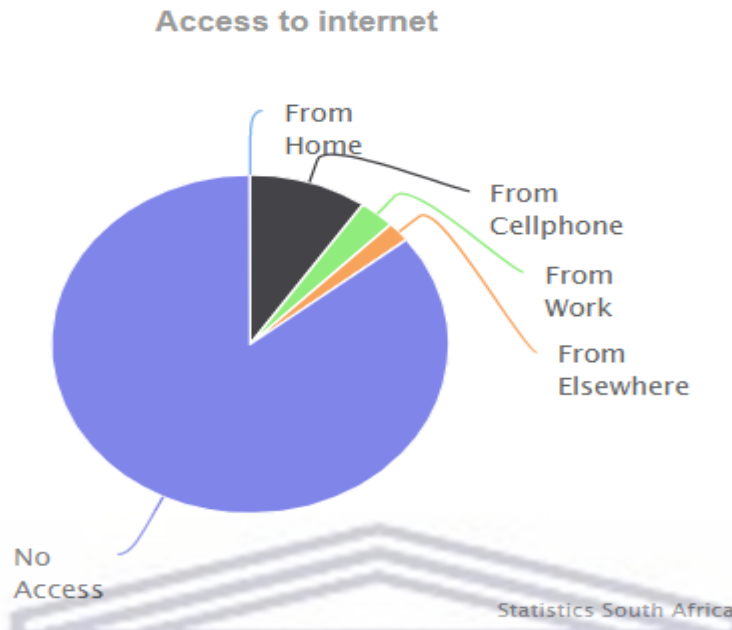


Figure5: Mankosi residents access rate to internet (DSI, 2022)

The presented pie chart illustrates the distribution of internet access among residents of Mankosi, emphasizing that the majority of the community lacked internet access before the implementation of the Zenzeleni project in the village. This project adopts a community-centric approach, aiming to address the self-defined needs and opportunities of the Mankosi community, situated in one of the most marginalized regions of the Eastern Cape.

Zenzeleni Communication's primary objective is to fulfill the community's basic needs and promote inclusive participation in the technological transformation. To achieve this, Zenzeleni Networks has implemented several key social innovation initiatives in the Mankosi region. These include the deployment and utilization of affordable technologies that community members can install, maintain, and operate. Additionally, a local business has been co-created, with its income being reinvested back into the community. Knowledge transfer and skill development are also prioritized, ensuring that community members gain and transfer valuable skills.

Furthermore, Zenzeleni Networks ensures access to a reliable backhaul network that is scalable and managed in a way that progressively reduces user costs, enabling a greater portion of local income to remain within the community. The initiative also engages with the broader telecommunication ecosystem to maintain compliance, access opportunities, and operational

efficiencies. By implementing these initiatives, Zenzeleni Networks aims to bridge the digital divide and empower the Mankosi community by providing them with sustainable and inclusive access to the benefits of modern technology.

4.5 Zenzeleni Networks Role in Community Development

DSI (2022) reports shows that Zenzeleni Networks originally, functioned as a local wireless intranet facilitating free voice services between analog phones linked by solar-powered routers. Subsequently, it integrated an external internet connection through a 3G modem, allowing phones to make calls to national numbers. In the course of these developments, the community identified the potential to utilize the solar station that powered the routers for charging phones. Consequently, the community initiated mobile phone charging services from the routers at a more affordable rate compared to local retail shops, establishing a beneficial income-generating opportunity through this social innovation initiative (GISW, 2018).



Figure 6: Mankosi resident installing solar system (DSI, 2022)

The image above depicts the active engagement of the Mankosi community in the installation of solar power in their residences. These initiatives resulted in significant outcomes, including a training program for 12 local youths to utilize the internet for applying to national tertiary

education grants an achievement noteworthy in an area where completing secondary education is uncommon. In 2014, Zenzeleni established a local cooperative with full ICASA license exemptions to operate and provide communication services. As Zenzeleni has advanced, it has assumed two parallel functions an overarching non-profit entity (Zenzeleni) and the local community-owned and operated Internet Service Provider (ISP), the Mankosi Cooperative. Zenzeleni presently furnishes affordable and dependable connectivity across several communities in the rural Eastern Cape province of South Africa, specifically in Mankosi, Mcwasa, Nomadolo, and Zithulele (APC, 2019). Similar to many other regions in the Eastern Cape and different parts of South Africa, these communities were intentionally and systematically underdeveloped by the racist and oppressive colonial and subsequent apartheid regimes. They face extremely high unemployment, profound poverty levels, substantial out-migration rates among economically active individuals, and limited economic infrastructure, primarily featuring general stores with basic products and limited tourist accommodations (Mdleleni, 2017).

As a consequence, more than two decades after the end of apartheid, unemployment in the area stands at approximately 98% (APC, 2019). Most residents subsist on around US\$1 per day, relying on government old age and childcare grants or remittances from relatives employed in urban areas. Telecommunications constitute a significant portion of the monthly expenses for these village residents, accounting for around 25% of monthly costs, as per a five-year study by UWC (APC, 2019). This is partly attributed to the necessity of telecommunications in a context where families are dispersed throughout the country, and the tariffs charged by formal service providers are deemed expensive for the inhabitants of this area.

In the South African context, Zenzeleni Networks exemplifies how economically marginalized communities relying on government grants can progress through a community network, gaining access to and ownership of high-value services in South Africa. Internet connectivity provides access to resources otherwise unavailable in these communities, and the new ISP business furnishes individuals with a fresh income stream. The collaboration and partnerships with external stakeholders, such as UWC, and the involvement of the government have proven essential for Zenzeleni Networks to overcome various legal, technical, financial, and social barriers experienced by these communities.

4.6 Case Study Summary

Zenzeleni Networks has emerged as a pioneering Internet Service Provider (ISP) in the Mankosi region, setting an important precedent for marginalized areas. The initiative has successfully connected over 3,500 individuals and 8 institutions, offering remarkably affordable prices that are up to 20% lower than those offered by existing operators. This case study of Zenzeleni Networks serves as a compelling example of how social innovation (SI) can effectively prepare marginalized communities for the arrival of the Fourth Industrial Revolution (4IR), ensuring inclusive participation in the ongoing technological transformation.

The transformative impact of Zenzeleni Networks is evident in the significant changes it has brought to rural areas, particularly in terms of connectivity and access to information. By bridging the digital divide, the initiative has opened up new avenues for communities to participate in the opportunities and benefits of the 4IR. Access to the internet and the wealth of information it provides can empower individuals, enhance educational opportunities, foster entrepreneurship, and enable communities to actively engage in the digital economy.

The success of Zenzeleni Networks exemplifies the potential of SI to drive positive change in marginalized regions. In prioritizing the needs and aspirations of the community, Zenzeleni Networks has not only established a reliable and affordable internet infrastructure but has also facilitated the emergence of a local cooperative, ensuring that the benefits generated by the initiative circulate back to the community. This bottom-up approach has empowered the community to take ownership of their telecommunication services and maximize the socio-economic advantages derived from them.

Furthermore, Zenzeleni Networks serves as a model for other underserved areas, demonstrating how SI can effectively address the challenges of connectivity and information access in marginalized communities. By fostering local knowledge transfer, promoting technological literacy, and engaging with the broader telecommunication ecosystem, Zenzeleni Networks has not only expanded connectivity but also contributed to the development of digital skills and the overall socio-economic upliftment of the region.

To this end, Zenzeleni Networks stands as a testament to the potential of SI to drive inclusive participation and prepare marginalized areas for the opportunities and challenges presented by the 4IR. By providing affordable connectivity and empowering communities, Zenzeleni

Networks has paved the way for transformative change in rural areas, enabling them to actively participate in the digital age and shape their own futures.

As such, the Zenzeleni Networks case study serves as a valuable exemplar of how SI can effectively leverage the opportunities presented by the 4IR to address the digital divide and empower marginalized communities. In adopting a comprehensive and inclusive approach, SI can play a pivotal role in ensuring that the benefits of the 4IR are accessible to all, thereby promoting social equity and sustainable development.



CHAPTER FIVE: FINDINGS AND DISCUSSION

According to Rey-Moreno and colleagues (2015) Zenzeleni Networks project in Mankosi Village serves as a remarkable example of how social innovation (SI) initiatives can profoundly impact marginalized communities, particularly in their endeavors to participate in the technological space. Zenzeleni Network case study is in line with the aims and objectives of this study, which is to establish the extent to which the uptake of 4IR can be enhanced through SI, subsequently promoting the inclusion and empowerment of marginalized individuals within the technological transformation. The study shed light on how the Zenzeleni Networks project has positively transformed the status quo of Mankosi area. This initiative exemplifies the potential of SI combined with 4IR technologies to develop the lives of the marginalized population. The findings of the study present a comprehensive analysis of the impact of the Zenzeleni Networks project in Mankosi Village. The analysis highlights the tangible improvements experienced by the marginalized individuals, resulting from their active engagement with SI and the adoption of 4IR technologies.

Zenzeleni Networks, through its innovative approach, has addressed various challenges faced by the marginalized community. It has provided the area of Mankosi with access to affordable and reliable telecommunication services, bridging the digital divide and enabling them to participate in the digital economy (Prieto-Egido et al., 2022). This newfound connectivity has opened opportunities for education, healthcare, entrepreneurship, and overall socio-economic development within the community. The SI project has also fostered a sense of empowerment and ownership among the marginalized individuals in Mankosi Village by involving them in the project's design, implementation, and governance processes (Takavarasha et al., 2018). Furthermore, DSI (2022) confirms that Zenzeleni Networks has empowered the community to actively shape their technological landscape, ensuring that their specific needs and aspirations are considered. Moreover, the integration of 4IR technologies within the Zenzeleni Networks project has further accelerated progress, which has resulted in improved service delivery, increased productivity, and enhanced socio-economic opportunities for the marginalized population.

5.1 Social Innovation Project in Mankosi Village

The case study of Zenzeleni Networks illustrates the transformative power of social innovation in marginalized societies (Takavarasha, 2018). In fostering community ownership, promoting economic empowerment, and addressing the skills gap, initiatives like Zenzeleni Networks pave the way for the inclusive development of marginalized communities in the digital age. The findings emphasize the significance of social innovation frameworks in enabling the transition of marginalized communities into the digital era and realizing their full potential in the face of social and economic challenges.

This section examines and delves into the results that have emerged from the analysis of the case study. There were five emerging themes from the presented case study that answer the research question of this study, these themes are:

- Theme 1: Enhancing skills
- Theme 2: Facilitating access to information and education,
- Theme 3: Advancing the local economy,
- Theme 4: Promoting advocacy and tribal authority,
- Theme 5: Enhancing healthcare services.

The section below focuses on unpacking the identified key themes that have emerged from the case study analysis.

5.2 Skills development (train the trainer)

Zenzeleni Networks provided digital literacy training to the residents of Mankosi, enhancing their digital skills and enabling them to fully utilize the services offered by the Fourth Industrial Revolution. Rey-Moreno (2015) believe that a crucial aspect of this progress was the implementation of the "Train the Trainer" program by Zenzeleni Networks in Mankosi village, which plays a vital role in aligning with the 4IR and promoting social innovation in marginalized areas.

In the context of the Fourth Industrial Revolution, where technology advancements and digitalization are reshaping various industries Buhr (2017) agrees that it is essential to equip individuals with the necessary skills to thrive in this technological shift. The "Train the Trainer" program by Zenzeleni Networks acknowledges this need and proactively addresses skill

development by training local trainers within Mankosi village (Takavarasha, 2018). This approach empowers the community to become self-sufficient in acquiring and disseminating knowledge related to technology and telecommunications. With technically proficient trainers, the community can effectively educate and empower other members, creating a ripple effect of skill development (Neumeier, 2017).

This approach strongly aligns with the principles of social innovation, as it empowers the local community to take control of their own development. According to Rey-Moreno (2015) training trainers, Zenzeleni Networks ensures that the skills and knowledge imparted are sustainable and can be continuously shared with others. This creates a multiplier effect, expanding the reach of skill development initiatives and fostering a culture of continuous learning within the community. Additionally, focusing on skill development in line with the 4IR, Zenzeleni Networks aims to bridge the digital divide and promote inclusivity, addressing gaps in access to technology (Rey-Moreno et al., 2015). This strategy ensures that individuals in Mankosi village are not only technology consumers but also active participants and contributors to the digital economy, improving their socio-economic prospects and promoting equitable development (Rey-Moreno et al., 2015).

Overall, the "Train the Trainer" program implemented by Zenzeleni Networks in Mankosi village showcases the power of skill development in driving social innovation and embracing opportunities presented by the Fourth Industrial Revolution. By empowering community members to become trainers and advocates of technology, Zenzeleni Networks contributes to the sustainable development of Mankosi village and paves the way for a digitally inclusive future. The image below depicts the youth of Mankosi attending training sessions to acquire basic digital skills, which are crucial in the technological era.



Figure 7: Youth of Mankosi attending Train the Trainer program (DSI, 2022)

5.3 Access to information to access to higher education

According to Schwab (2016) access to information and higher education are vital elements of social innovation (SI) and aligning with the Fourth Industrial Revolution (4IR). In that context, Zenzeleni Networks in Mankosi village recognizes the significance of bridging the digital divide and promoting equitable access to information and educational opportunities (Takavarasha, 2018). Through their telecommunications network and initiatives, Zenzeleni Networks plays a crucial role in expanding access to information in Mankosi village. Buhr (2017) believe that providing reliable and affordable internet connectivity, community members can access a vast array of knowledge and resources available online. This access to information empowers individuals to pursue educational opportunities, engage in lifelong learning, and stay informed about local and global developments. Additionally, Zenzeleni Networks contributes to higher education by enabling distance learning and online education initiatives (DSI, 2022). With the advancements of the 4IR, online platforms and digital tools have become indispensable for remote education and skills development. Providing internet

connectivity to Mankosi village, Zenzeleni Networks opens doors to online courses, virtual classrooms, and educational resources that were previously out of reach.

Manda and Dhaou (2019) emphasize that the development of policies and strategies addressing digital transformation is a basic requirement from the government to ensure that 4IR opportunities and challenges are realized by all. The access to information and higher education opportunities has transformative effects on the community. Schwab's (2017) mentioned that access to information and higher education allows individuals to expand their knowledge, develop new skills, and enhance their employability, it also fosters a culture of lifelong learning and intellectual growth, empowering individuals to adapt to the ever-changing demands of the 4IR. In line with SI, Zenzeleni Networks ensures that the benefits of access to information and higher education are not limited to a privileged few (Rey-Moreno, 2015). Through community-driven initiatives, Zenzeleni Networks actively involves the local community in shaping and utilizing these resources. This approach promotes inclusivity, local ownership, and the sustainable development of educational initiatives tailored to the specific needs of Mankosi village (Rey-Moreno, 2015).

Leveraging the power of technology and connectivity, Zenzeleni Networks demonstrates how access to information and higher education can be democratized and made available to all. It does not only empower individuals within Mankosi village but also contributes to the overall social and economic advancement of the community (DSI, 2022). In the context of the 4IR, Zenzeleni Networks serves as a catalyst for SI, enabling individuals to thrive in the digital era and actively participate in the global knowledge economy.

Furthermore, Zenzeleni Networks' provision of affordable voice and data services to rural communities, including Mankosi, has helped bridge the digital divide and enable these communities to participate in the technological space and the global economy. This addresses one of the major challenges faced by marginalized communities in South Africa, where adequate and affordable connectivity is crucial for them to fully realize the benefits of the 4IR.

5.4 Expand Local Economy

Zenzeleni Networks' social innovation project in Mankosi village has a multi-faceted approach to promoting progress in the community. The project primarily centers on enhancing access to information and education, while also nurturing entrepreneurship, digital skills, and employment prospects (Rey-Moreno, 2015).

One of the key aspects of the project is the provision of reliable and affordable internet connectivity. This enables community members to explore entrepreneurial opportunities and access online business ventures, expanding their customer base and tapping into regional, national, or even international markets. The project also emphasizes skills development and training, equipping individuals with technical expertise and digital literacy, which in turn opens up a wider range of employment opportunities for them.

Zenzeleni Networks' initiative encourages local innovation and creativity by making information and educational resources readily available, supporting cultural tourism, and fostering a sense of pride and identity within the community. In addition, Gleason (2018) agrees that supporting existing businesses by enhancing their operations and extending their reach through the internet for marketing, communication, and online transactions, the project also promotes collaboration and networking. Mahmood and Mubarik (2020) highlight that connecting individuals, businesses, and organizations, the initiative encourages knowledge sharing, resource pooling, and partnerships, leading to joint ventures, cooperative initiatives, and mutually beneficial projects. This collaborative environment contributes to the growth of the local economy and creates a supportive ecosystem for entrepreneurship. Zenzeleni Networks operates on a cooperative model, owned, and operated by its members (Rey-Moreno, 2015). This means that any profits generated by the cooperative are reinvested back into the community, ensuring its sustainability and benefiting the community in the long term.

Overall, Zenzeleni Networks' social innovation project in Mankosi village leverages technology and connectivity to improve the local economy, fostering opportunities for entrepreneurship, employment, innovation, and collaboration. This holistic approach leads to sustainable economic growth and prosperity for the community.

5.5 Advancement of Advocacy and Accountability

The Zenzeleni Networks project in the Mankosi region seems to be a well-rounded initiative that goes beyond just providing internet connectivity. It emphasizes advocacy efforts and community empowerment to create a more inclusive and equitable society. Below is the summary of the key points:

1. **Advocacy and Collaboration:** The project collaborates with the Tribal Authority and other stakeholders to amplify local voices and address the specific needs and challenges of the community. This collaborative approach allows the Tribal Authority to advocate for the needs and aspirations of the Mankosi region, engaging in local governance and decision-making processes to represent the community's interests at larger scales (Rey-Moreno et al., 2015).
2. **Inclusive Connectivity:** The project advocates for policies and initiatives that promote affordable and accessible internet connectivity for all community members, regardless of their socioeconomic status. Gleason (2018) mentioned that the focus during the digital era should be on ensuring that no one is left behind in the digital era to promote more inclusive and equitable society.
3. **Community Empowerment:** Zenzeleni Network also focuses on empowering the community through digital literacy and skills development initiatives. The Zenzeleni project is in line with Manda and Dhaou (2019) emphasis, which is on equipping community members with the necessary knowledge and skills to navigate the digital landscape. Rey-Moreno and colleagues (2015) confirmed that the project promotes self-reliance and active participation in the digital economy.
4. **Collaboration with Stakeholders:** The project fosters collaboration with various stakeholders, including governmental organizations, NGOs, and other community-based initiatives. This collaboration strengthens the advocacy efforts by combining resources, expertise, and influence to bring about positive change.
5. **Sustainable Development:** The overall aim of the project is to advocate for positive change and equitable access to opportunities for all community members. In addressing the unique challenges of the community and promoting digital inclusion and empowerment, the project contributes to the sustainable development of the Mankosi region (George, 2018)

In summary, the Zenzeleni Networks project in the Mankosi region demonstrates a bottom-up approach to community development, leveraging advocacy, collaboration, and empowerment to create meaningful impact in the community. By involving the Tribal Authority and other stakeholders, the project addresses the specific needs of the community and advocates for policies and initiatives that promote a more inclusive and connected society.

5.6 Enhanced Health Services

The Zenzeleni Networks project in Mankosi village has not only brought about improvements in the technological aspect but has also had a significant impact on the provision of healthcare services.

1. **Telemedicine and Remote Consultations:** The reliable internet connectivity provided by Zenzeleni Networks enables telemedicine services, allowing community members to access medical advice, diagnosis, and treatment remotely (Takavarasha 2018). This reduces the need for extensive travel and physical presence, making healthcare more accessible and convenient.
2. **Health Education and Awareness:** Online platforms supported by the network facilitate vital health awareness campaigns, educational resources, and preventive care information. This helps in spreading health education and creating awareness among community members, empowering them to make informed decisions regarding their well-being (DSI 2022).
3. **Emergency Response and Information Exchange:** Zenzeleni Network enables swift communication and information exchange between healthcare providers, emergency response teams, and community members. This facilitates efficient emergency services and the timely dissemination of critical information, improving response times and overall emergency management (DSI 2022).
4. **Support for Community Health Workers:** The project supports community health workers by providing connectivity and resources. This enables them to access training materials, guidelines, and real-time support from healthcare professionals, enhancing their effectiveness in providing healthcare services to the community (Takavarasha 2018).

Overall, the presence of Zenzeleni Networks in Mankosi village has brought about significant improvements in healthcare services. By leveraging technology and connectivity, the project has bridged the gap in access to healthcare and contributed to the improvement of healthcare services in Mankosi village.



5.7 Chapter Summary

Chapter 5 of the study delves into the Zenzeleni Networks project in Mankosi Village, presenting it as a significant illustration of the profound impact that social innovation initiatives can have on marginalized communities, especially in their pursuit of participation in the technological realm. Aligned with the study's objectives, which seek to explore how the adoption of the 4IR can be elevated through SI, the Zenzeleni Network case study underscores its role in fostering the inclusion and empowerment of marginalized individuals in the technological transformation. The chapter sheds light on the positive transformation brought about by the Zenzeleni Networks project in the Mankosi area. It exemplifies the potential of combining SI and 4IR technologies to enhance the lives of the marginalized population. Through a comprehensive analysis, the study reveals the tangible improvements experienced by individuals in Mankosi Village as a result of their active engagement with SI and the adoption of 4IR technologies.

Zenzeleni Networks, through its innovative approach, has successfully addressed various challenges faced by the marginalized community. By providing affordable and reliable telecommunication services, the project has bridged the digital divide, enabling the community to participate in the digital economy. This newfound connectivity has unlocked opportunities in education, healthcare, entrepreneurship, and overall socio-economic development within the community. The SI project has not only improved access to services but has also instilled a sense of empowerment and ownership among the marginalized individuals in Mankosi Village. Their involvement in the project's design, implementation, and governance processes has played a crucial role in fostering a participatory and inclusive approach. Additionally, Zenzeleni Networks has empowered the community to actively shape their technological landscape, ensuring that their specific needs and aspirations are considered. The integration of 4IR technologies within the project has accelerated progress, leading to improved service delivery, increased productivity, and enhanced socio-economic opportunities for the marginalized population.

In summary, Chapter 5 highlights the transformative impact of the Zenzeleni Networks project in Mankosi Village, showcasing how a combination of social innovation and Fourth Industrial Revolution technologies can uplift and empower marginalized communities in the face of technological transformation.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study delved into the significance of social innovation (SI) in the context of the Fourth Industrial Revolution (4IR) in South Africa, with a specific focus on ensuring inclusive participation in the current digital transformation, particularly among marginalized communities. The primary objective was to examine the impact of the 4IR on marginalized groups and identify the potential roles that SI can play in facilitating their participation in this technological revolution.

To achieve this objective, the study adopted a comprehensive approach that involved reviewing relevant literature alongside empirical evidence derived from a case study. The case study specifically explored the role of SI in addressing the unique challenges faced by marginalized communities during the 4IR.

One notable example examined in this research was Zenzeleni Networks, which served as a case study illustrating the potential of SI to harness the opportunities presented by the 4IR. The Zenzeleni Communication case study provided valuable insights into how SI can effectively address social and environmental challenges, including the digital divide, the scarcity of technological skills, and energy poverty.

By analyzing the Zenzeleni Networks case study, this research aimed to shed light on how SI can be leveraged to bridge the gap between marginalized communities and the benefits of the 4IR. The findings of this study highlighted the transformative potential of SI in enabling inclusive participation and empowering marginalized groups to overcome the barriers they face in accessing and benefiting from the current technological revolution.

The integration of literature review and empirical evidence in this study provided a comprehensive understanding of the roles that SI can play in driving social and economic development in marginalized communities. By addressing issues such as the digital divide and technological skills gap, SI can contribute to reducing inequalities and promoting sustainable growth in the context of the 4IR.

Zenzeleni Community network has emerged as a remarkable example of a sustainable and cost-effective alternative to traditional telecommunications providers. By utilizing low-cost, open-

source technology and adopting a community-based ownership and governance model, Zenzeleni has not only revolutionized the telecommunications landscape but also empowered local communities and stimulated economic growth.

The case study findings indicate that socially innovative projects, such as Zenzeleni Networks, play a significant role in enhancing community social sustainability. By increasing social capital and providing resources for the empowerment of marginalized individuals, these initiatives contribute to the preservation of social cohesion and the well-being of the community (Garcia et al., 2015). Furthermore, the analysis conducted in this study highlights how social innovation can effectively address the skills gap and prepare marginalized societies for the challenges and opportunities presented by the Fourth Industrial Revolution (4IR). The case of Zenzeleni Networks exemplifies how such initiatives can provide the necessary skills and knowledge required to thrive in the digital era, equipping individuals with the tools to actively participate in the 4IR. The success of Zenzeleni Networks also underscores the potential of community-driven projects to overcome the social and economic challenges faced by marginalized communities. Through the implementation of a social innovation framework, Zenzeleni has transformed these communities, allowing them to embrace the digital era and unlock new opportunities for growth and development.

6.2 Recommendations

From the Zenzeleni Communication case study, the study proposes the following recommendations, which can be adopted for other marginalized areas to ensure inclusive participation in technological transformation.

- **Develop a sustainable business model:** Zenzeleni Communication was able to achieve financial sustainability by developing a business model that combined both commercial and community service aspects. This model enabled the company to generate income from commercial services, which were then used to fund community services.
- **Engage the community:** The success of Zenzeleni Communication was largely due to the active participation and engagement of the community. The company should continue to involve the community in decision-making and ensure that their needs and preferences are considered in the provision of services.

- **Leverage technology:** Zenzeleni Communication leveraged low-cost, open-source technology to build their network infrastructure. The company should continue to explore new technologies and innovations that can help them improve their services while keeping costs low.
- **Establish partnerships:** Partnerships with other organizations, including government agencies, NGOs, and private sector companies, can help Zenzeleni Communication expand its reach and impact. The company should continue to establish partnerships that can help them access new resources and expertise.
- **Develop local capacity:** Zenzeleni Communication was able to create jobs and build local capacity by training and employing community members to install and maintain the network infrastructure. The company should continue to invest in training and developing local capacity to ensure the sustainability of their operations.
- **Focus on social impact:** Zenzeleni Communication was founded with a social mission, and the company should continue to prioritize social impact in its operations. This includes providing affordable and accessible communication services to underserved communities and addressing the digital divide.

The study concludes that the Fourth Industrial Revolution (4IR) is impacting many African countries, including South Africa, offering the potential to address persistent issues of poverty, unemployment, and inequality. However, the research highlights the current limitations in resources, infrastructure, and skilled workforce in South Africa, hindering the full realization of 4IR opportunities, especially in marginalized areas. As a recommendation, the study suggests a focused government effort to enhance coordination and resilience in both the public and private sectors. This involves building economic competency and technological capability through robust economic policies, fostering digital skills through education, enforcing legal frameworks for regulating the digital space, and providing essential physical infrastructure, including digital and supportive infrastructure like reliable electricity. Furthermore, the study proposes making data prices affordable for the economically disadvantaged to facilitate access to information and communication technologies (ICT) and connectivity. Overall, the recommendations highlighted above are necessary for South Africa to successfully adopt and utilize the potential benefits of 4IR, and to address the current challenges faced by marginalized societies.

In conclusion, the study underscored the importance of SI in ensuring inclusive participation in the 4IR, particularly among marginalized communities. Through the examination of the Zenzeleni Networks case study and the synthesis of relevant literature, this research demonstrated the potential of SI to address social and environmental challenges, empower marginalized groups, and bridge the gap between them and the opportunities of the 4IR.

6.3 Limitations

While the study on the Zenzeleni Networks project in Mankosi Village provides valuable insights, it's crucial to acknowledge its limitations. Some potential limitations within the study include:

Generalizability:

The specific context of Mankosi Village may limit the generalizability of findings to other regions or communities. Different socio-economic, cultural, and geographical factors may influence the outcomes of similar initiatives elsewhere.

Temporal Constraints:

The study's timeframe may be relatively short, potentially limiting the ability to capture long-term effects and changes brought about by the Zenzeleni Networks project. Longer observation periods could provide a more comprehensive understanding of sustainability and impact.

Research Bias:

Research bias may exist due to the involvement of researchers or institutions closely associated with the Zenzeleni Networks project. This potential bias could influence the interpretation of results and the framing of the study.

Technological Changes:

Rapid advancements in technology may outpace the study's findings. The dynamics of the telecommunication industry and technological landscape could have evolved since the completion of the research, affecting the relevance of certain conclusions.

6.4 Future Work

This section highlights future work which can be done within the scope of this research.

Long-Term Impact Assessment:

Conduct a longitudinal study to assess the sustained impact of the Zenzeleni Networks project over an extended period. This would help understand the long-term effects on socio-economic development, community empowerment, and technology adoption.

Replication and Scalability:

Investigate the potential for replicating the Zenzeleni Networks model in other marginalized communities, both within the region and globally. Assess the scalability of the project and identify factors that contribute to its success or challenges faced in different contexts.

Policy Implications:

Explore the policy implications of the Zenzeleni Networks project and its success in bridging the digital divide. Investigate how policy frameworks can be adapted or developed to support and encourage similar initiatives in other regions, aligning with broader national and international development goals.

Community Capacity Building:

Focus on community capacity building initiatives that empower local residents to take on more active roles in managing and expanding telecommunication services. This could involve training programs, skill development, and capacity-building efforts to enhance the sustainability of the project.

Technological Innovation:

Explore opportunities for technological innovation within the Zenzeleni Networks project. Investigate emerging technologies that could further enhance connectivity, service delivery, and community engagement in the marginalized communities.

References

- Abdelnour, Samer. "Beyond South Africa: Understanding Israeli apartheid." (2013).
- Adendorff, C., Lutshaba, U. and Shelver, A., 2018. Policy implications of the 4th industrial revolution for the cultural and creative economy. *Submitted in Department of Arts and Culture, Nelson Mandela University.*
- Ayentimi, D.T. and Burgess, J., 2019. Is the fourth industrial revolution relevant to sub-Saharan Africa?. *Technology analysis & strategic management*, 31(6), pp.641-652.
- Bai, C., Dallasega, P., Orzes, G. and Sarkis, J., 2020. Industry 4.0 technologies assessment: A sustainability perspective. *International journal of production economics*, 229, p.107776.
- Braun, V., Clarke, V. and Hayfield, N., 2022. 'A starting point for your journey, not a map': Nikki Hayfield in conversation with Virginia Braun and Victoria Clarke about thematic analysis. *Qualitative research in psychology*, 19(2), pp.424-445.
- Buhr, D., 2017. What about welfare 4.0?. In *CESifo Forum* (Vol. 18, No. 4, pp. 15-24). München: ifo Institut-Leibniz-Institut für Wirtschaftsforschung an der Universität München.
- Creswell, J.W. and Poth, C.N., 2009. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.
- Hlatshwayo, M., 2019. Precarious work and precarious resistance: a case study of Zimbabwean migrant women workers in Johannesburg, South Africa. *Diaspora Studies*, 12(2), pp.160-178.
- Hofisi, C., Hofisi, M. and Mago, S., 2014. Critiquing interviewing as a data collection method. *Mediterranean Journal of Social Sciences*, 5(16), p.60
- Kosinski, M., Matz, S.C., Gosling, S.D., Popov, V. and Stillwell, D., 2015. Facebook as a research tool for the social sciences: Opportunities, challenges, ethical considerations, and practical guidelines. *American psychologist*, 70(6), p.543.

Lekhanya, L.M., 2019. Public outlook on creative methodologies for the 4th industrial revolution in South Africa. *International Journal of Entrepreneurship*, 23(3), pp.1-13.

Mahmood, T. and Mubarik, M.S., 2020. Balancing innovation and exploitation in the fourth industrial revolution: Role of intellectual capital and technology absorptive capacity. *Technological Forecasting and Social Change*, 160, p.120248.

Manda, M.I. and Ben Dhaou, S., 2019, April. Responding to the challenges and opportunities in the 4th Industrial revolution in developing countries. In *Proceedings of the 12th international conference on theory and practice of electronic governance* (pp. 244-253).

Manda, M.I. and Ben Dhaou, S., 2019, April. Responding to the challenges and opportunities in the 4th Industrial revolution in developing countries. In *Proceedings of the 12th international conference on theory and practice of electronic governance* (pp. 244-253).

Maynard, A.D., 2015. Navigating the fourth industrial revolution. *Nature nanotechnology*, 10(12), pp.1005-1006.

McKay, G., 2021. A place for 4IR in transforming shame in returning migrants. *Shame 4.0: Investigating an Emotion in Digital Worlds and the Fourth Industrial Revolution*, pp.495-509.

Naudé, W., 2017. Entrepreneurship, education and the fourth industrial revolution in Africa.

Nel, M. and Schoeman, W.J., 2015. Empirical research and congregational analysis: Some methodological guidelines for the South African context. *Acta Theologica*, pp.85-102.

Neumeier, S., 2017. Social innovation in rural development: identifying the key factors of success. *The geographical journal*, 183(1), pp.34-46.

Oke, A. and Fernandes, F.A.P., 2020. Innovations in teaching and learning: Exploring the perceptions of the education sector on the 4th industrial revolution (4IR). *Journal of Open Innovation: Technology, Market, and Complexity*, 6(2), p.31.

Osika, G., 2019. Social innovations as support for Industry 4.0. *Zeszyty Naukowe. Organizacja i Zarządzanie/Politechnika Śląska*.

Prieto-Egido, I., Simó-Reigadas, J., Castro-Barbero, E. and Tacas, R.Q., 2022, June. Expanding Rural Community Networks Through Partnerships with Key Actors. In *International Conference on Human-Computer Interaction* (pp. 417-435). Cham: Springer International Publishing.

Rey-Moreno, C., Tucker, W.D., Cull, D. and Blom, R., 2015, May. Making a community network legal within the South African regulatory framework. In *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development* (pp. 1-4).

Roblek, V., Thorpe, O., Bach, M.P., Jerman, A. and Meško, M., 2020. The fourth industrial revolution and the sustainability practices: A comparative automated content analysis approach of theory and practice. *Sustainability*, 12(20), p.8497.

Schwab, K., 2017. *The fourth industrial revolution*. Currency.

Schwab, K., 2018. the Fourth Industrial Revolution (Industry 4.0) a Social Innovation Perspective. *Tạp Chí Nghiên Cứu Dân Tộc*, 7 (23), 12–21. Perspective,” *Tạp chí Nghiên cứu dân tộc*, 7(23), pp. 12–21. doi:10.25073/0866-773x/97.

Sutcliffe, A. and Hart, J., 2017. Analyzing the role of interactivity in user experience. *International Journal of Human–Computer Interaction*, 33(3), pp.229-240.

Sutherland, E., 2020. The fourth industrial revolution—the case of South Africa. *Politikon*, 47(2), pp.233-252.

Takavarasha Jr, S., Adams, C. and Cilliers, L., 2018. Community networks for addressing affordability of ICT access in African rural areas: A case study of Zenzeleni, Makhosi. In *Affordability Issues Surrounding the Use of ICT for Development and Poverty Reduction* (pp. 1-27). IGI Global.

Todaro, M. and Smith, S.C., 2011. Chapter 5: Poverty, inequality, and development. *Economic Development, 11*.

Tull, K., 2019. Guidance, standards, and protocols in the humanitarian sector on reducing harm to the environment

Van Rensburg, N.J., Telukdarie, A. and Dhamija, P., 2019. Society 4.0 applied in Africa: Advancing the social impact of technology. *Technology in Society, 59*, p.101125.

Waidner, M. and Kasper, M., 2016, March. Security in industrie 4.0-challenges and solutions for the fourth industrial revolution. In *2016 Design, Automation & Test in Europe Conference & Exhibition (DATE)* (pp. 1303-1308). IEEE.

Weyer, S., Schmitt, M., Ohmer, M. and Gorecky, D., 2015. Towards Industry 4.0-Standardization as the crucial challenge for highly modular, multi-vendor production systems. *Ifac-Papersonline, 48(3)*, pp.579-584.

Yin, R.K., 1994. Discovering the future of the case study. Method in evaluation research. *Evaluation practice, 15(3)*, pp.283-290.

Yin, R.K., 2009. *Case study research: Design and methods* (Vol. 5). sage.



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APPENDIX 1: Ethical Clearance for Data Collection



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13 December 2021

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HSSREC Reference Number: HS21/10/12

Project Title: A deeper look at the advent of the Fourth Industrial Revolution (4IR) and what it means for the marginalized, a Social Innovation perspective.

Approval Period: 25 November 2021 – 25 November 2024

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology, and amendments to the ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:

<https://sites.google.com/uwc.ac.za/permissionresearch/home>

The permission letter must then be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse events and/or termination of the study.

Ms Patricia Josias
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University of the Western Cape

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