DURBAN UNIVERSITY OF TECHNOLOGY

AN ASSESSMENT OF THE IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION ON MANUFACTURING SMALL AND MEDIUM ENTERPRISES: A CASE STUDY OF DURBAN, SOUTH AFRICA.

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AN ASSESSMENT OF THE IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION ON MANUFACTURING SMALL AND MEDIUM-SIZED ENTERPRISES: A CASE STUDY OF DURBAN, SOUTH AFRICA

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ABSTRACT

Small and Medium-sized Enterprises (SMEs) play a significant role in economies of both developing and developed countries. They are one of key strategies in combating socio-economic issues such as poverty, unemployment, and inequality. For this reason, it is crucial that they are sustained and elevated as the world is progressing from the third industrial revolution to the fourth industrial revolution(4IR).

The aim of the research is to assess the impact of the fourth industrial revolution on manufacturing SMEs in Durban, South Africa. Manufacturing SMEs in Durban contribute about 20% of the gross value added to the economy of the city, which is a significant contribution. It is therefore imperative to uncover how the advancements in technology due to 4IR impacts this sector. A non-probability snowball sampling technique was used to obtain a sample of 20 respondents who were either owners or people in high management positions in Durban's Manufacturing SMEs. Data was collected through structured interviews and analysed using content analysis, a qualitative data analysis technique.

The results suggest that manufacturing SMEs in Durban know about 4IR. According to their understanding, 4IR is an enhanced and all-inclusive system that fuses physical, digital, and technological systems, built on prior revolutions to improve business processes, business growth and transformation through modern smart and intelligent technologies. The study recommends that manufacturing SMEs should prioritize education and training, innovate their business models to accommodate policies that relate to technological disruptions. They should also invest on innovation, research and development, and smart infrastructure and investment. Finally, this research suggests that SMEs in different industries do comparable studies to determine the effects of 4IR. The results further support a proposal for a study that evaluates the effect of Covid-19 on the use of 4IR by manufacturing SMEs in Durban.

Keywords: Fourth Industrial Revolution, Small and Medium-sized Enterprises, Technology

DECLERATION

I, the undersigned, Mlondi Eugene Khuzwayo declare that this dissertation is based on my research and that I have not, and no one has submitted this dissertation to any other institution of higher learning to obtain an academic qualification.

15/8/2023

Student: Mr. M. E. Khuzwayo Date

15-08-2023

Supervisor: Dr. L. J. Zogli Date

DEDICATION

This dissertation is dedicated to:

My mother, for the role she played in teaching me entrepreneurship. My son, Nsika. You inspire me to go on, mfanakithi.

My late father, Titizana Snr. As I grow, I learn to embrace and draw positives from unfortunate passing. We should honour death. Most importantly, we should embrace life.

My immediate family for igniting the dream and desire to take another step-in life.

SMEs, for the role that they play in fighting poverty, especially in rural areas.

Every individual who has a dream, nothing is out of reach if you believe.

ACKNOWLEDGEMENTS

Reflecting on the journey, the valleys and hills, and sleepless nights, especially my “Academic Fridays” when this was just an idea and a dream, until I pinned that last full stop on this dissertation, the only thing that come to mind and make perfect sense is that it can only be God. He enabled and carried me throughout. I always found confidence in the fact that he (God) will carry me all the way up to completion of the good work that he started with me. Indeed, nothing is out of reach, I continue to believe.

To kwaMaphumulo, emaMbedwini my place of upbringing. Borrowing from former South African President Thabo Mbeki’s famous piece of creativity in a poem titled “I am an African”, I owe my being to the hills and the valleys, the mountains and the glades, the rivers and trees of the beautiful land of Ngqokwane, Hlonono and Ndleleni “*Inkosi yebhulukwe*”. Through its citizens, young and old, I have developed and continue to grow. It is through their direct and indirect guidance and mentorship that I found purpose and direction. Indeed, it takes a village to raise a child.

My close family. Mom Dudu, my sister Nomalungelo, my brother iSboniso samaMbedu, and my four lovely nephews. I appreciate you sharing our family's history with us because it is a great source of motivation. The entrepreneurial being in me was one of many things that we were all exposed to, developed, and fostered. If I had the option to pick a family again, I would still choose you. uTitizana kaZethwese, kaNyekevu, my late father, died in 1989 when I was only 13 months old. Even now, 34 years later, I'm still motivated by his departure to always take responsibility. Because of him, I am and always will be my hero. Nsika, my son. My world has changed since your birth.

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To my academic mentors, career mentors and friends who supported me from day one, you continue to play a pivotal role in my growth and development. Your contribution is valued beyond measure. I am because you are. Thank you!

To the Manyathi family, my cousin brother Scelo, his dear wife and kids. Thank you for the immense contribution. It added a significant value to the flow of my juices of creativity.

To my friends who have consistently offered support during this journey, I couldn't have done it without you.

"And we all know that all things work together for good to those who love God."- Romans 8:28.

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Abbreviations

AI	Artificial Intelligence
BIP	Black Industrialist Programme
Covid-19	Coronavirus
COSATU	Congress of South African Trade Unions
CPS	Cyber-Physical System
GDP	Gross Domestic Product
GEM	Global Economic Monitor
GPS	Global Positioning System
ICT	Information & Communication Technology
IT	Information Technology
KZN	KwaZulu Natal
OBT	Opportunity-Based Theory
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
SA	South Africa
SAAMP	South African Automotive Masterplan
SEDA	Small Business Development Agency
SME	Small and Medium Enterprises
SSA	Statistics South Africa
TAM	Technology Acceptance Model
TR	Technology Readiness Model
TRA	Theory of Reasoned Action
UNISA	University of South Africa
UN	United Nations
USA	Unite State of America
WEF	World Economic Forum
4IR	Fourth Industrial Revolution

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CHAPTER 1

INTRODUCTION

Introduction and Background of the Study

Small and Medium-sized Enterprises (SMEs) at a global level are key vehicles for economic growth and development (Rogerson, 2000; Sitharam and Hoque, 2016; Claudia, Ribau and Moreira, 2018; Shaikh, Mumbai, Kumar, Syed, Shaikh, 2021). They play a crucial role in fighting socio-economic challenges such as inequality, unemployment, and poverty by creating job opportunities, wealth and generating income, particularly for economically marginalised populations (Robu, 2013; Mmbengwa, Groenewald, and Van Schalkwyk, 2013; Claudia *et al*. 2018). Various governments across the globe regard SMEs as a focal point of configuration, nation building and economic elevation (Aderemi, Charles, Adedayo and Busayo, 2019).

Worldwide, SMEs represent about 90% of existing businesses, contributing more than 50% of employment, with approximately 70% being formal jobs (Cantú, Aguiñaga and Scheel, 2021). Likewise, in the African continent, SMEs play a similar role of contributing significantly to economic growth and development (Smit and Watkins, 2012). For instance, in South Africa, SMEs accounted for almost 90% of all businesses' operations, created above 50% of all employment and contributed 33% towards the gross domestic product by 2017 (Jili*,* Masuku and Selepe*,* 2017). Even though the absolute number of businesses registered as SMEs in South Africa decreased by 2,7% between Quarter 2 (Q2) and Quarter 3 (Q3) of 2021, the year-on-year change indicated a growth of 1,7% between 2020 Q3 and 2021 Q3 (SEDA, 2021). SMEs remain a lifeblood of the country's economy as more than 90% of all formal businesses in the nation are SMEs, accounting for up to 60% of all employment, and up to 39% to the country's GDP (Rajagopaul, Magwentshu, and Kalidas, 2020; News24, 2022). Therefore, it is vital to support, grow, and preserve SMEs even as the world is progressing from the third industrial revolution to the fourth industrial revolution with regards to knowledge, power, and wealth of people and industries.

4IR is a new era dominated by emerging technologies that impact and blur physical, digital and biological distinctions of both living and transacting, subsequently brewing both the positives and negative for SMEs (Guoping, Yun and Aizhi, 2017; Min Xu, David and Suk Hi Kim, 2018). SMEs usually show least resilience during seasons of calamity, due to smaller clientele, fewer cash reserves, and less capacity to deal with commercial pressures when compared with bigger businesses (Rajagopaul *et al.* 2020). The lower level of durability has been evident during the devastating phase of the global pandemic (Covid-19) that threatened the global economic outlook and impacted all businesses negatively.

Businesses modified already existing and introduced new business models to stay afloat during this devastating phase. Manufacturing businesses intensified the automation of work approach and process, a technological component of the fourth industrial revolution to continue operating during strict lockdown regulations that negatively affected their operations. This intended to minimise the movement of people and person-to-person contact, to minimise the spread of Covid-19.

As a result, the introduction and adopting pace of new technologies such as digital marketing, online trading and virtual meetings, etc as components of 4IR were more rapid when compared to the third industrial revolution. Whilst numerous studies on SMEs continue to contribute towards their stabilisation and improvement, however the awareness and effects of the fourth industrial revolution specifically to manufacturing SMEs remain a least researched area. This study therefore seeks to provide insight into this subject by assessing the impact of the 4IR on manufacturing SMEs owners or managers in Durban, KwaZulu Natal.

1.2 Research Problem

Contrary to the global socio-economic contribution of SMEs, 20% fail with their first year of operation, while 50% survive beyond the fifth year of operation (Milošević, Mihajlović and Stojanović, 2019). In developed economies such as the United States of America (USA), approximately 33% of SMEs fail during the first two years, 50% fail within five years, and 33% survive for ten years or more (Horton, 2022). Emerging markets such as Malaysia and Nigeria indicated that they fail to sustain and grow within their first five years of existence. Inadequate business and management skills, finance inaccessibility, poor infrastructure and

technological capability are identified as common factors that cause this failure (Khalique, Isa, Shaari and Ageel, 2011; Emezie, 2017). In 2018, South African SMEs had one of the world's highest failure rates with more than 75% of new small businesses failing within their first year of operating (Leboea 2017; Tseka, 2018). This is further confirmed by 2.7% SME ownership decline in 2021 Q3 when compared with 2021 Q2, with KwaZulu Natal (KZN) recording an annual decline of 5.3% (SEDA Q3 2021). When analysing factors that affect the performance of SMEs, particularly in KZN, South Africa, managerial competency and skills, access to finance and technological capabilities emerge as the fundamental internal environment factors that determine the life or death of SMEs (Sitharam *et al.* 2016). It is therefore logical and justified to conclude these aspects are important in deciding SME's success or failure.

The manufacturing sector is identified as one the biggest influencers of growth in the country's GDP, having contributed 13% towards South Africa's GDP in September 2021 (Parker, 2022). In Durban alone, the third most populous city, the manufacturing sector contributes almost 20% of the metro's Gross Value Added (GVA) (District Economic Profiles, 2021). In ensuring that this sector continue to grow in South Africa, small businesses particularly those in manufacturing remain an area of focus, with government having established programmes such as (South African Automotive Master Plan) and the (Black Industrialists Programme) to enhance opportunities such as new partnerships and outsourcing contracts within this sector (Statistics South Africa, 2019).

To analytically understand and measure these factors and the impact thereof, it is important for studies to also explore these factors individually. This study therefore intends to contextualise challenges that result to failure of SMEs within the component of technological capabilities by assessing the impact of the 4IR on manufacturing SMEs. It seeks to extend the exploration of these new technologies when interpolated with physical and biological environment under the fourth industrial revolution in manufacturing sector. Beyond the incremental increase in efficiency, 4IR introduces yet another rapid change to the entire structure of the world's economy, societal and human behaviour through utilising connected technologies and digital domains as a daily practice to manage lives (Philbeck and Davis, 2019).

Furthermore, it poses a rapid industrial shift globally, that can present both opportunities and threats to both small and big companies (Schwab, 2016). Under this revolution, technological diffusion is expected to have a swift technical and socio-economic impact (Morrar, Arman and Mousa, 2017). These rapid technological changes also have an impact on innovative leadership and its ability to acquire modern technologies (Ngibe and Lekhanya, 2019). The fourth industrial revolution introduces a change in society behaviour on a physical, digital, and biological level through new technologies including artificial intelligence, the internet of things, genetic engineering, biotechnology, materials science, and block chains. (Schwab, 2017). As a result, it goes beyond introducing new technologies. But it is expected to redesign and reshape the general nature of business through disruptive innovation (Min Xu *et al*. 2018).

It will also cultivate new products, services, markets, minimise production costs. Subsequently, this will benefit consumers and stimulate economic growth (Schwab, 2015; Jee, 2017). However, adverse effects such as inequality, job losses through automation, talent monopoly, ethical, moral consideration and cybersecurity threats are also anticipated to arise along with these opportunities (Min Xu *et al*. 2018). Significantly, the number of SMEs that fail within the first five years of existence poses a threat of sustainability to the already frail South African. In addition to this, SME failure due to technological issues is on the rise in South Africa (Bushe, 2019). This study therefore intends to assess the impact of 4IR on manufacturing SMEs in Durban.

1.3 Aim of The Research

Resulting from the above research problem, this study seeks to assess the impact of 4IR on manufacturing SMEs in Durban, South Africa. Through research questions and objectives, it will evaluate factors that influence manufacturing SMEs on 4IR awareness, perceptions, majors of this awareness and implications.

1.3.1 *Research Questions*

Arising from this aim, the following questions are posed.

What is the level of awareness of 4IR among manufacturing SMEs in Durban, KZN?

What are the factors that influence the awareness of 4IR among manufacturing SMEs in Durban KZN?
What is the level of technology acceptance among manufacturing SMEs in Durban KZN?
What is the general perception on 4IR among manufacturing SMEs in Durban, KZN?

1.3.2 *Research Objectives*

In probing the research problem, the following objectives were developed:

To ascertain level of awareness of 4IR among manufacturing SMEs in Durban, KZN.
To determine factors that influence the awareness of 4IR among manufacturing SMEs in Durban, KZN.
To ascertain the level of technology acceptance among manufacturing SMEs in Durban KZN.
To identify the general perception on 4IR among manufacturing SMEs in Durban, KZN.

1.4 Significance of the study.

Globally, SMEs are key economic drivers in both developing and developed countries. They contribute significantly to economic growth and are regarded as one of the instrumental tools in addressing socio-economic issues such as inequality, unemployment and poverty (Heinicke, 2018). By 2018, they accounted for approximately 70% of unemployment reduction, and 60% of employment in developed economies such as the United Kingdom (Tikakul and Thomson, 2018). In South Africa, SMEs are recognised as the backbone of the economy, accounting for more than 98% of businesses. They also employ between 50% and 60% of the country's work force across all sectors (Rajagopaul *et al*. 2020). It is therefore imperative that these enterprises thrive amid their micro and macro challenges, such as lack of business managerial competency, skills, access to finance and technological capabilities.

To ensure the above conclusion, it is imperative to conduct continuous research that contributes to knowledge development, and the discovery of solutions to offset these challenges and enhance growth through the discovery of opportunities. A study of this nature assessed the impact of the 4IR on manufacturing SMEs. Furthermore, this study critically and strategically identified opportunities that can contribute to the sustainability and growth of this industry. Whilst there is continuous research on challenges that threatens SMEs that

seek to come up with solutions to these challenges and strengthen these enterprises, this study, through its findings provided useful information about the level of awareness of fourth industrial revolution among Durban-based manufacturing SMEs. These findings also capacitate current and future entrepreneurs, and the general society with critical knowledge from which growth sustainability can be attained.

1.5 Structure of The Study

1.5.1 *Chapter 1: Introduction and background of the study*

This chapter provides a summary of the study's history, problem statement, research aims, research questions, and research objectives to introduce the research topic and define the study's context. It also discusses the significance and design of this research.

1.5.2 *Chapter 2: Literature Review*

This section explores entrepreneurship, South African SMEs though literature, various definitions within the context of this research, 4IR, opportunities and threats. Critically defining these terms is vital so that they are clearly understood within the parameters which this discussion will be underpinned. It is structured along the objectives of the study, particularly to ascertain the impact of 4IR among manufacturing SMEs, factors that influences their awareness, the level of technology acceptance, and identify their general perception on 4IR. The purpose of this review of the literature is to construct a link between the theoretical framework, the conceptual framework, and the study's main study objective. It further enlightens on 4IR, its market disruptions, and emphasis on various features of this revolution, technology penetration and acceptance rate in South Africa. It also critically identified some of the opportunities and threats that arise from this revolution. This will be built on the key theoretical paradigms and technology readiness model that will form basis in which the research findings will be contextualised.

1.5.3 *Chapter 3: Research Methodology*

The methodology applied and the rationale for the research design choice will be presented in Chapter 3. Furthermore, this chapter describes and explains the research methodology employed, the research design, target population, methods for data collection and analysis limitations, and study delimitation.

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1.5.4 *Chapter 4: Analysis, Findings and Discussions of The Study*

The research inquiry's findings are presented in this chapter. The data gathered through surveys is analysed, evaluated, and presented.

1.5.5 *Chapter 5: Summary, Conclusions and Recommendations*

Findings and recommendations for all related stakeholders are detailed in this last chapter. To identify future research directions, the study's objectives, limitations, and research questions are reviewed.

1.6 Scope of the study

The study was limited to 40 business owners/managers of manufacturing SMEs in the Durban area (eThekwini Metropolitan Municipality) in KZN province. In the event where owners were not available, managers were interviewed. 20 business owners/managers participated in interviewers.

1.7 Conclusion

This chapter served as an in-depth introduction of the study by discussing the background of SME's and the 4IR within the context of what this study aims to establish. It also outlined chapters that this research project contains. The main topics covered in this chapter included, but were not limited to, the research problem, research aim, introduction, and background of the study, followed by research questions and objectives presented to frame the quality of the study. Furthermore, it discussed the rationale for the study, and provided a brief insight on the structure of this study. The introduction and premise of the study, a sample of the literature review on the topic under investigation, the research methodology applied, and the rationale for the research design were all included in this structure. It also outlined how data was to be collected, analysed, and presented as findings in adherence to ethical considerations, and in line with the objectives of this research project. Lastly, it provides guidelines on how and to whom findings and recommendations are presented.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter firstly lays out a thorough outlook of the South African economy. Herein, an overall outlook of the nation's economy is provided which includes the contribution of SMEs to the economy. Furthermore, a critical review of the theoretical framework that guides this study is provided. This is followed by a detailed analysis of the 4IR, the existing literature and its implications among manufacturing small and medium enterprises. Lastly, a detailed description of the conceptual framework is given. SMEs significantly contribute to the socio-economic development of any nation by advancing economic growth though the creating jobs, increasing manufacturing output, commercial capabilities and enhancing exports (Shaikh *et al*. 2021). South Africa is not an exception.

Several studies have confirmed that despite the significant role SMEs play in a nation's economy, their sustainability and growth is still a major challenge (Leboea, 2017; Tseka, 2018). In South Africa, they are among the lowest when compared with other transitioning economies, having recorded the highest failure rate of 75% in 2016 (Msomi and Olarewaju, 2021). Over the past two decades, managerial competency, efficiency and technical skills, access to finance, technological capabilities and infrastructure, adoption challenges, lack of organisational support and lack of governmental support have been common challenges that result to their failure, as their relationship with performance and sustainability is directly proportional (SEDA Q1, 2018; Tang, Park, Agarwal and Feng Liu, 2020; Shaikh *et al.* 2021).

Based on technology as a component of 4IR, this chapter aims to inform the reader about this progression, relate the theoretical and conceptual frameworks, with the principal research objectives of the study, which is to evaluate how 4IR will affect small and medium- sized businesses in general, and manufacturing SMEs in particular that are based in Durban. Chapter two will also introduce the reader to the key theoretical paradigms (Technology Readiness Model & Opportunity-Based Theory).

2.2 Theoretical Framework

Theories are constructed to explain a phenomenon, draw connections, and make predictions (McCombes, 2020). Hence in a research study, a theoretical framework serves the purpose of defining key concepts, as well as illustrating assumptions and expectations that guide a research study. Theories that guide a research study are selected using the criteria of the most relevant theory to the study as they are based on existing knowledge, observations, and ideas of a certain topic (*ibid*). For this research study, the researcher has selected two theories that best complement the study's aim, these are the Technology Readiness Model and the Opportunity-Based Theory.

The technological readiness model measures a person's overall mental state because of the interaction of their mental enablers and inhibitors, and it may be used to assess whether they are ready to adopt and use new technologies (Parasuraman, 2000). Currently, technologies already represent a $350 billion market, and expected to grow up to $3.2 trillion by 2025 (Technology and innovation report, 2021). These modern technologies are expected to positively influence the future, from climate action and better health to more democratic and inclusive societies (Technology and innovation report, 2021).

Therefore, it is important for businesses including SMEs to integrate the 4IR to remain at par with all their rivals. However, it is important to evaluate and monitor technology and its impact to neutralize the threats it poses to SMEs. Winter et.al (2021), acknowledges the importance of technology in improving the quality of life of the world population. Perceived usefulness is benefited immensely by technology readiness. It is therefore, upon these premises that the researcher considers the Technology Readiness Model best suitable to successfully to assess the impact of 4IR on manufacturing SMEs in Durban, South Africa, factors that influence their awareness, perceptions, majors of this awareness and implications. Opportunity-Based Theory on the other hand drives about 75% of South African entrepreneurs, with only 25% being necessity-driven (Global Economic Monitor report, 2018).

Many entrepreneurship researches and findings confirm the discovery of opportunities as the starting point of the entrepreneurship process (Shane and Venkataraman, 2000; Korsgaard, 2013; Alvarez and Barney, 2020). Despite the identification of opportunities that produces South African SMEs, there are other essential factors (Murphy and Marvel, 2008). These

elements include, but not limited to assembling resources, managing a business concerns and threats that arises along operations, growing a business venture, and others. It is important to note that the Opportunity-Based Theory does not apply to these elements that incorporate various phenomena. It only applies during emerging stages. Thus, this theory complements the aim of this study as it aids in the analysis of opportunities presented by the 4IR to South African manufacturing SMEs.

The hypotheses are from a variety of technology, business, and entrepreneurial theories. They are based on the following criteria: the significance of the theories, their applicability to the ultimate design of the research model, the "goodness" of the theoretical assertions made within the theories, lastly, their value in the fields of technology and entrepreneurship. Even though good theories tend to inspire research, the theoretical framework contains majority of what is known about corporate competitiveness (Fink, 2010). However, in challenging the theory parenthesis, often abstract concepts and hypotheses are combined to form a theory, which attempts to provide meaning to complex phenomena (Dugan, 2017). Through the exploration and articulation of these theories, this study attempts to address the main research problem that is stated in chapter one.

2.2.1 Technology Readiness Model

The Theory of Reasoned Action (TRA), which is an adaption of the Technology Acceptance Model (TAM) states that behavioural intention has an influence on how the technology is used (Elliott, Meng and Hall, 2012). A person's readiness to adopt and use modern technologies can be measured using Technology Readiness (TR). This is viewed as an overall state of mind produced by the interface of mental enablers and inhibitors (Elliott, Meng and Hall, 2012). Although TR has demonstrated usefulness in assessing the overall attitude towards technology, it has limited applicability in the adoption of other technologies, such as mobile applications (Jin, 2016).

Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) of the system often determine the user's interest and belief (Lin and Chang, 2018). Initially, TAM included attitude (attitude-towards-using) as a variable. However, this was removed due to its ineffectiveness in mediating the relationship between user interest and belief (Ling and Hsieh 2018). In conjunction with the aforementioned, when technology is perceived useful and simple to use,

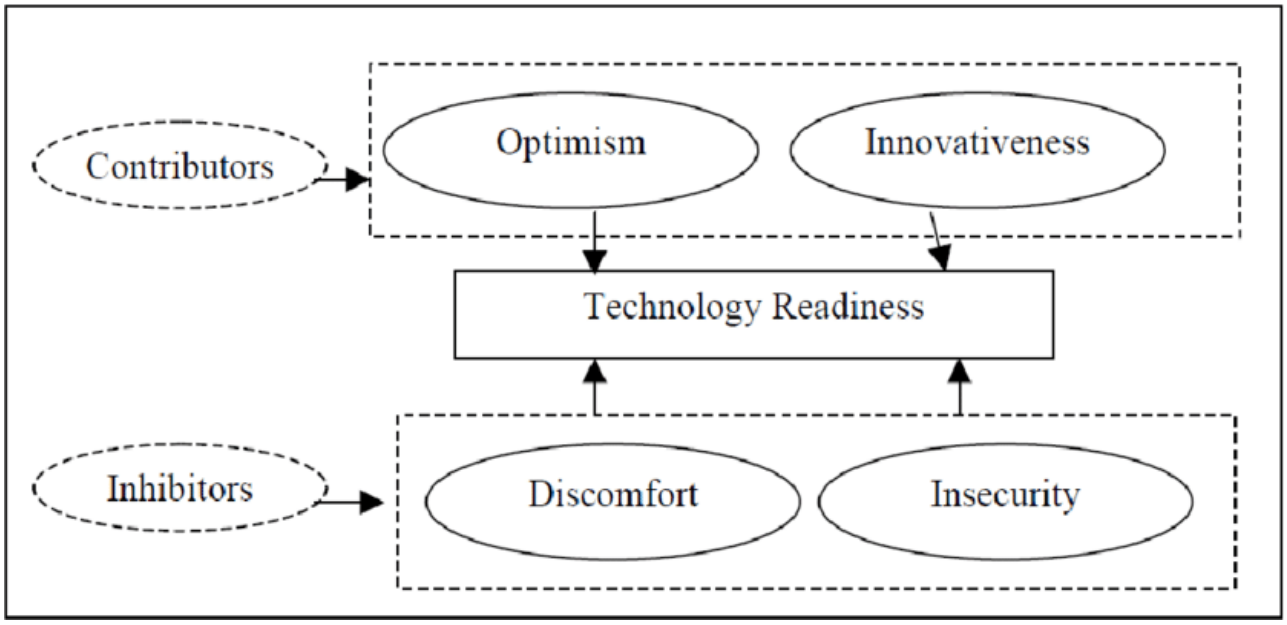
users can have a positive attitude and be more motivated to utilise it.
This ultimately led to

acceptance and actual use (Parasuraman, 2000; Mai, Yoshi and Tuan, 2016). For this reason, TAM has evolved into a model that is used to forecast attitudes, willingness, and behaviours related to the usage of new technology (Mai *et al*. 2016).

Technology Readiness Model is also defined as people's ability to embrace and utilise new technologies for home and professional purposes (Ling *et al*. 2018). It is therefore argued that the way someone perceives technology can be both positive and negative. It results to four characteristics of technology readiness namely, optimism, inventiveness, discomfort, and insecurity (Ling *et al*. 2018). The optimism dimension represents a positive attitude toward technology and the benefits of using it to increase productivity and performance, both at work and at home (Mishra, Akman and Mishra, 2014). Innovativeness dimension as another positive personal perception of technology that measures how keen a person is to experiment with technology attempt new goods or services based on modern technology (Park, 2017). Contrary to the positive perception about technology, discomfort and insecurity dimensions respectively show lack of confidence, low self-esteem, and apprehension about employing the newest technologies.

This model is therefore represented in the figure below.

Figure 2.2.1: Technology Readiness Model



Source: Ling *et al.* (2018)

These dimensions (discomfort and insecurity) represent a negative perception about technology. Although this has nothing to do with the characteristics of discomfort that indicate general discomfort with technology, the insecurity factor fosters mistrust of transactions involving technology and uncertainty about its viability (Roy and Moorthi, 2017). Optimism and innovativeness, the first two dimensions of technology readiness, are "contributors" that may improve readiness to use technology, while discomfort and insecurity, the latter two dimensions, are "inhibitors" that may reduce readiness to use technology. This model is an expansion and adaption of the TRA, which was created initially by Fishbein and Ajzen (1975). Rooted in social psychology, TRA entails to examine a collection of "determinants of conscious behavioural patterns". (Lin *et al*. 2018). Individuals' behavioural intentions to engage in specific behaviours are directly affected by the relative strength of their attitudes and subjective norms (Taylor, Voelker and Pentina, 2011). In TRA, a person's behaviour is intricately linked to the action that one intends to carry out, with that behaviour being the consequence of both their subjective norms and attitudes (Roy *et al*. 2017). A fundamental tenet of TRA is the notion that people's beliefs about the outcomes of a certain behaviour have a substantial impact on their perceptions, and eventually their intention to participate in that behaviour. (Wentzel, Diatha and Yadavalli, 2013).
Additionally, TRA can explain consumer behaviour when using technology, computer systems. (Jin, 2016). Although TAM is a much less broad model, as it was first designed to just relate to computer usage behaviour before becoming more widely used across all information systems, TRA serves as the base for TAM (Lin *et al*. 2018). Like TRA, TAM is premised on the idea that an individual's behavioural intention to adopt is the outcome of a combination of both external factors and internal beliefs, which subsequently influences the behaviour towards adopting new technologies. (Mai *et al*. 2016).

These internal beliefs and external variables drive one’s perception on the ability to use technology and its usefulness. TAM is used to describe and predict information technology acceptance and usage behaviour. (Wentzel *et al*. 2013). One can therefore regard TAM as an effective model for predicting technology acceptance behaviours. There are two fundamental beliefs that are reflected in TAM which, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis *et al*. 1989). These two perceptual beliefs are presented as key determinants in the adoption of new technologies (Lin *et al*. 2018).

According to PU, it is a person's belief that a technology will "increase his or her job performance within an organisational context, while PEOU refers to how strongly a prospective user believes that adopting a technology will be "free of effort" or "user friendly," making it easier and more enjoyable to use. As a result, the ease of use of a system affects how much a person enjoys it (Mishra *et al*. 2014; Mai *et al*. 2016).

Both PEOU and PU have a direct impact on a person's behavioural intentions and ensuing attitude toward embracing modern technologies. Additionally, PEOU is a factor in PU because it has an impact on how quickly people accept modern technology. (Mishra *et al.* 2014). This suggests that if a person is unable to use a certain piece of technology efficiently, their PU toward that device may be decreased. (Parasuraman, 2000). Despite TAM being considered effective at predicting technology adoption behaviour, questions can be raised about its applicability to broader marketing settings, as it was initially developed to explain technology adoption, mandated by organisational objectives, in the constrained environment of the workplace (Park, 2017). TAM used in a context of marketing may not be able to effectively express why customers choose to use a certain technology because of the significant level of involvement required by customers to co-produce a service with mobile self-service technologies (Roy *et al*. 2017).
This is due to TAM's failure to take into consideration how consumers' general opinions about technology affect their PU and PEOU toward a particular technology when adoption is not compelled by organisational goals. (Taylor *et al*. 2011). In agreement with the above, a model that considers individual differences (TR) must be incorporated to make TAM better applicable in marketing contexts (Wentzel *et al*. 2013), (Yang, Kim and Yim, 2019). To consider how customers and businesses utilise and accept new technologies, technology readiness and acceptance model (TRAM) was proposed the TRAM to increase the application and explanatory power of TR and TAM (Yang *et al.* 2019).

The suggested model adds the personality characteristics of TR to the two system-specific aspects of TAM (PEOU and PU) (Wentzel *et al*. 2013). There is a connection between these two models (TAM and TR), with personal technological beliefs (TR) being closely tied to PU and PEOU. The applicability of TAM in business settings where customers are not obliged to adopt a specific technology has been questioned, even though it has succeeded at foreseeing the adoption of specific technologies (Wentzel *et al*. 2013; Jin, 2016; Yang *et al.*

2019). Similarly, TR is a good model for identifying people's general opinions toward technology, but it overlooks system-specific features like PEOU and PU, making it impossible for TR to explain why people with high TR do not always adopt new technologies (Parasuraman 2000). As a result, the user's TR is positively correlated with both PU and PEOU, rendering it a determinant of both beliefs (Roy *et al*. 2017).

To enforce this view, the degree to which a person is ready (TR) to use new technology determines both PU and PEOU (Jin, 2016). Moreover, the psychosocial factors of TR such as innovativeness, optimism, insecurity, and discomfort are intimately associated to the mental aspects of TAM that is PEOU and PU (Jin, 2016). As such, when analysing the utilisation of technology in this study of manufacturing SMEs in Durban, KZN, optimism and innovativeness, two positive TR dimensions, lead to higher levels of PU and PEOU, while discomfort and insecurity, two negative TR dimensions, lead to lower levels of PU and PEOU (Martin, 2016). In addition, PU and PEOU effectively modulate the relationship between people's attitudes towards technology (TR) and their propensity to embrace and employ it (Martin, 2016). For this reason, TR has a favourable impact on PEOU and perceived levels of technology usage (Roy *et al*. 2017). However, contrary to PU having a direct effect on technology adoption, PEOU does not (Yang, Pang, Liu, Yen and Tarn. 2015). This is a result of PU and PEOU having a good relationship, with PEOU having a secondary effect on technological adoption (Yang *et al.* 2015). To improve the applicability of TR to particular technologies, these two tenets, PU and PEOU of the technology acceptance model are blended into TR to create the technology readiness and acceptance model (TRAM) (Yousafzai and Yani-de-Soriano, 2012). This method (TRAM) integrates the system-specific aspects of TAM with the TR personality dimensions to increase both constructs' capacity for description. (Yang *et al*. 2019; *Yang et al*. 2015). TAM was originally designed to explain the acceptance of technological systems within a predetermined working environment (Yun, Won, and Park, 2016), however its applicability to the adoption of technologies within more general marketing settings has been challenged (Yang *et al*. 2019).

By including people's attitudes toward technology in general (TR) and their views of a technology (TAM), the integrated model (TRAM) addresses the limitations of TR and TAM (TAM). For this reason, TRAM is more effective than either of the individual constructs (TR or TAM) at explaining and predicting people's propensity to embrace new technologies,

particularly in situations when adoption is not mandated within an organisational environment (Yun *et al*. 2016). The theory of reasoned action (TRA), which argues that a person's actions are determined by their intentions to take those actions, is crucial in determining how 4IR will affect manufacturing SMEs. Furthermore, TRA is predicated on the idea that people's TR on a system's use is influenced by their attitude toward technology, which is in turn influenced by the PU and PEOU of the system (Martin-Domingo and Martin, 2016).

These two components lead to intention, which in turn influences behaviour (Matiki, Roberts-Lombard and Mpinganjira, 2016). The idea that behavioural intentions and actual usage are directly related is another tenet of this philosophy (Mekic, Ozlen and Kumbara, 2014). Decisions made by individuals are therefore based on their actions rather than their beliefs and ideas. The fundamental belief is that SMEs' TR and decision to utilise such technology are influenced by factors including their inventive and hopeful attitude toward the system as well as their uneasiness and insecurity with the system (Nath, Bhal and Kapoor, 2014).

2.2.2 Opportunity-Based Theory of Entrepreneurship

The opportunity-based theory of entrepreneurship is a complement to the theory of reasoned action (TRA), which claims that a person's actions are dependent on their intentions to do those actions. A theory that supports the theoretical framework, embedded in the field of entrepreneurship. By 2018, up to 75% of South African entrepreneurs were opportunity driven, with only 25% being necessity-driven (Global Economic Monitor report, 2018). This therefore gives the opportunity-based theory of entrepreneurship and upper hand in the South African context, when compared with other theories. Moreover, the discovering of opportunities is where the entrepreneurial process starts, and this is following most entrepreneurship studies (Shane *et al*. 2000).

According to this theory, the majority of entrepreneurship research opportunities are extensively drawn from theories and methodologies of other social science fields, including the field of business studies in general (Prasanna, Jayasundara, Gamage, Ekanayake, Rajapakshe and Abeyrathne, 2019 2019). Entrepreneurship scholars acknowledged that opportunities have unique conceptual characteristics (Venkataraman, 1997). However, this is often overlooked due to their fundamental and unique character that required research for

these opportunities to come to life (Kim, Park and Joh, 2019). As a result, other opportunities are missed by the conventional theoretical structures in those fields, which has hindered novel theoretical breakthroughs. Entrepreneurship research focuses on the identification, assessment, and use of potential future goods and services (Venkataraman, 1997). Its definition does not require that the same individual or company engage in all aspects of the entrepreneurial life cycle, nor does it necessarily include or exclude the development of an organisation (Kim *et al*. 2019).

According to the definition, entrepreneurship starts with opportunity. Opportunities are new means-ends frameworks that allow for the introduction and implementation of a variety of new products, services, raw resources, markets, and organizing principles in a market system (Kim *et al*. 2019). Only a handful of individuals usually take advantage of an opportunity like this because it needs progress, but the consequences can be beneficial to many people. The most fundamental principles from psychology, sociology, economics, marketing, and other domains have been addressed in entrepreneurship study. While little-by-little improvements have been achieved in this direction, theories and approaches from other disciplines are unlikely to offer anything new. Recognised opportunities, for instance, have an objective, independent quality that may develop independently of their discoverers. These characteristics go outside of the model parameters of most economics' models (Prasanna *et al*. 2019). However, there is an existing view which argues that the discovery and exploitation of profitable opportunities is the central concern of entrepreneurship research (Shane *et al*. 2000). Similar to these views, Kim *et al*. (2019) defines the concept of entrepreneurship, as a process of first creating an opportunity and then pursuing it.

This makes entrepreneurship a nexus of two phenomena: the existence of lucrative possibilities and the existence of ambitious individuals (Shane and Eckhardt, 2003), and therefore endorses the creation and exploitation of opportunities to be the core of entrepreneurship (Nugroho, 2015). Entrepreneurship begins with the identification of opportunities, which is the responsibility of the entrepreneur (Berringer and Greening, 2018). This process is reliant on the entrepreneur's choice. Typically, exploitation occurs within the business that through its capabilities, converts opportunities into market outcomes (Berringer *et al*. 2018).

Figure 2.3.2: Opportunity Based Approach to Entrepreneurship

Source: Shane *et al.* (2000)

Figure 2.3.2 shows that three dimensions can be applied to study opportunity processes: opportunity formation, opportunity decision, and opportunity exploitation. These largely coincide with the major research issues regarding entrepreneurship (Shane *et al.* 2000).

There are three main reasons why, when, and how opportunities for the production of goods and services exist. (1) Why, when, and how some people discover and take advantage of these opportunities while others do not; (2) why, when, and how different modes of action are implemented to benefit from these opportunities. This theory suggests that the research focus on entrepreneurialism ought to not be limited to just manufacturing SMEs and the South African (opportunity exploitation) aspect, but to why, when, and how 4IR opportunities are formed and the decision is made to pursue such opportunities. In the context of the 4IR, opportunities, however, are not just discovered; they are created (Berringer *et al.* 2018).

Opportunities are not thought to be purely objective phenomena brought on by external shocks to a market or business. Instead, they develop endogenously as a result of the actions and reactions of businesspeople who are looking for new ways to manufacture goods or services. Entrepreneurial prospects frequently need to be "created" by putting human desires into tangible products and markets (Venkataraman, 1997). Future market segments are, by definition, not existing and do not exist (Prasanna *et al.* 2019). Many potential futures are currently imaginable, based on "more or less" educated reflections. But which future will materialise will rely on decisions that have not yet been made? This implies that the entrepreneur develops 4IR opportunities for SMEs in KwaZulu-Natal endogenously through

the process of discovery or creation. Figure 2.3.2 suggests that the process of entrepreneurial opportunity formation influences both opportunity decision and opportunity exploitation.

2.3 The South African Economy

2.3.1 *Background*

In 1994, South Africa saw a new dawn as it gained its independence which was presumed as the beginning of economic prosperity and inclusion (Du Plessis and Smit, 2006). The first decade of a democratic South Africa (1995-2004) recorded an average real GDP growth of 3%. This was a substantial improvement when compared with the preceding decade (1985 - 1994) where the average growth rate was 0,8% (Du Plessis and Smit, 2006). Even though the country has undergone remarkable development post democracy, the second decade of democracy (2005-2014) experienced a declining economy, with an average of 2.8% GDP growth rate (Macrotrends, 2023).

Unemployment and inequality remained a constant threat, despite these economic gains. By 2005, South Africa had only managed to reduce unemployment by 0.77% (Macrotrends, 2023). Between 2005-2007, the South African economy experienced a spurt, as it recorded an annual GDP exceeding 5% in each consecutive year (Bhorat, Stanwix and Yu, 2014). This was a predecessor to the global financial crisis in 2008-2009, when the national economy suffered consequences with a negative economic growth during this period. Bhorat *et al*. 2014) indicate that despite the global financial crisis being short-lived, the South African economy has not managed to fully recover.

2.3.2 The current economic status

Over the past decade, the South African economy has experienced, unstable electricity supply, rising fiscal deficits, the rise in government debt, negative credit ratings and declining investment inflows (Meyer and Mothibi, 2021). It only managed an average growth rate of 1% between 2011 and 2021 (Macrotrends, 2023). Consequently, it has shifted from being dependent on the non-renewable economy to an economy that is characterised by a sophisticated, globally competitive financial services sector. The Covid-19 pandemic and the Russia-Ukraine war has inflamed economic volatility across the world, including South Africa.

In the second quarter of 2022, the South African gross domestic product (GDP) declined by 0.7%. Notably, manufacturing industry weakened by 5.9% and became one of seven out of ten industries that declined during this very quarter (Stats SA, 2022). As expected, this reflected itself in the unemployment rate that seating at 34.5% (Stats SA, 2022).

It is worth highlighting that two factors of an economy, income and non-income dimensions reveal contrasting information about the current state of the South African economy. Even though non-income welfare indicators such as housing, water, electricity show an improvement in the economic standing (Bhorat et.al, 2014; The World Bank, 2018; Stats SA, 2019; Stats SA, 2022). However, the image portrayed by income dimension is somewhat different as inequality has increased drastically, with unemployment rate on a constant spike, currently being the highest globally (Naidoo, 2021). It is upon these premises that the SMEs are the hope of an ailing South African economy with little growth prospects and ever-increasing unemployment. SMEs are globally envisioned to be the key drivers of jobs in society. Globally, approximately 60%-70% of the working population are employed in SMEs which make up about 95% of enterprises (ibid). However, SMEs, one of the main indicators of any country's economy, acknowledge that South Africa is undergoing a challenging phase, making the conditions unsuitable for business to thrive (Neneh and van Zyl, 2017).

2.3.3 *Business Environment*

The business environment is among the most significant and crucial components of a company's ecosystem due to its direct impact on the decisions, strategies, processes, and results. It is a combination of multiple complex, dynamic, controllable, and uncontrollable factors within which every business operates (Akpoviroro, Owotutu and Akanmu, 2018). These factors are subdivided into two major components, namely the internal and external business environments. Internal environments entail components such as finance, marketing, operations, personnel, and general management while external environments include the economical, technological, social, demographic, political and legal aspects of the business. External environments on the other hand are conditions and forces outside the business that are vital to the success of its operation and influences its activities.

This research study focuses on an external environment, namely the technology, the application of ever-evolving scientific knowledge on human life. It is the application of this scientific knowledge in businesses to produce and deliver goods and services faster and cheaper.

2.3.3.1 *Technological Environment of a Business.*

Technological environment presents a platform to create new business opportunities that enhances research and development, and innovation (Capobianco, Basile, Loia and Vona, 2021). This is a component upon which 4IR is constructed. 4IR constitutes of modern, sophisticated technologies that interpolates three worlds (Min Xu *et al*. 2018). It is noteworthy to emphasise that major technological advancements in automation, including robots, communication, and information, were made over the past few years during the third industrial revolution. They present both opportunities and threats. Businesses are therefore encouraged to utilise their strength to gain from opportunities that are presented by the 4IR and neutralise the threats.

2.4 Fourth Industrial Revolution

4IR has been proposed by the World Economic Forum to define the drastic and accelerated development of technologies and their impact on society at large on how it lives and works (Burritt and Christ, 2017). In this world, people employ connected technology to enable and control their daily lives as they navigate between offline reality and digital realms (Min Xu *et al*. 2018).

This new industrial revolution is defined by the advancement of digital and cognitive technologies along with biology and physical sciences, their fusion, and their application to the physical world (Heinis, Hilario and Meboldt, 2018). Contrary to the preceding industrial revolution, 4IR is defined by a fusion of technologies that are blurring the barriers between the physical, digital, and biological domains (Schwab, 2016). Through their advances, these new technologies are poised to upend society, business, and government. By adopting the usage of emerging technologies like artificial intelligence (AI), big data analytics, and blockchain, 4IR period presents new opportunities that potentially allow developing countries to shorten development stages and align with developed economies (Feng, Zhang and Zhou, 2018). As a result, numerous governments are already utilising this industrial revolution

driven by digital technology to enhance their social and economic inclusion through the development of a smart society (Howells, 2020).

However, if developing country governments do not embrace the digitally driven 4IR, they risk falling behind in terms of socio-economic development at a time when advanced countries and their enterprises would benefit from simple access to these countries' markets. Governmental organisations like the United Nations have also highlighted the significance of technology in accomplishing the Sustainable Development Goals that were adopted by member states in 2015. (Kodama and Shibata, 2015). As a result, it is expected that 4IR will have a positive impact on the creation of demand, that is, new businesses, brought about by new technologies (Jaafar and Ramayah, 2017), which is expected to subsequently create new markets and jobs (Schiuma, 2017).

In the 4IR, a customer may be someone who does not physically experience products or services, and even those who can potentially become customers in the future should also be included in the category of customers (Qwerty, 2017). During this era, existing products are modified or even merged to create new products for multi-functionality and interconnectivity. This is to cater for the physical, digital and biological spheres. Today, a cell phone today is not only a mobile communication device. But it is a GPS, bank, health device, computer, work tool, music device, diary, food ordering device and security device.

2.4.1 *Features of The Fourth Industrial Revolution*

Fourth Industrial Revolution has distinguished itself from previous revolutions due to its rapid rate, breadth, and depth of convergence as well as its immediate influence on industries, firms, governments, and entire societies (Schwab, 2017). By 2017, it enabled increased capital intensity and more flexible models of work organisation through advancements in machine-to-machine information and communication technologies, as well as annual efficiency gains from resource productivity in manufacturing of between 6% and 8% (Schiuma, 2017). This reflects the size and speed of the impact, through these disruptions that new and promoted technologies has in the manufacturing industry and business in general. According to Schulz, Gott, Blaylock and Zuazua (2018), new and promoted technologies include the following.

2.4.1.1 *4IR-Related Technologies*

- **Robotics and artificial intelligence**

Developed of robotics, equipped with new technologies in mechatronics, electrical engineering, and computers to carry out jobs that are difficult and beyond the scope of human intelligence, speed, and ability.

- **Ubiquitous linked sensors/ Internet of Things**

The use of network sensors to interconnect, track, and manage systems, grids, and products from a distance.

- **Additive manufacturing**

Innovations in manufacturing, including the 3D bio-printing of biological tissues and the use of a variety of materials and techniques.

- **Advanced materials and nanomaterials**

The development of novel materials and nanostructures to achieve desirable material properties, such as form preservation, thermoelectric efficiency, and new functionality.

- **Energy capture, storage and transmission**

Improvements in the efficiency of fuel cells, solar, wind, and other renewable energy sources; smart grid systems for distributing energy; wireless energy transfer; and more.

- **New computing technologies**

New hardware architectures for computers, such as those based on quantum, biological, or neural network processing, as well as creative upgrades to existing computing technology.

- **Biotechnologies**

Innovations in synthetic biology, biological computing interfaces, genetic engineering, medicines, and sequencing.

- **Big Data**

When large, intricate collections of structured and unstructured data are introduced as high-volume, high-velocity, or high-variety information assets, they need to be processed in creative, cost-effective ways to enhance insight, decision-making, and process automation.

- **Neurotechnology**

Smart medicines, neuroimaging, and bioelectronic interfaces are examples of innovations that enable for reading, communicating, and influencing human brain activity.

2.4.2 *Impact of the fourth industrial revolution.*

Living, working and trading patterns are changing at an unprecedented speed in history of industrial revolutions because of 4IR (University of Johannesburg, 2022). A collection of modern technologies enhances value chain in organisations. It creates digitised systems and network integration via smart systems that replaces existing ways of performing tasks with humans by automating them, using machines of high intelligence (Kayembe, Nel 2019). On businesses, technology is one of the critical drivers of 4IR. As a result, is has a direct impact on all components of business, such as products, service, markets, consumers, and labour. Cloud computing, the internet of things (the development of smart products), the internet of services (smart logistics and smart mobility), and the internet of energy (the effective use of natural resources) are just a few of the technologies that have taken on a significant role (Baur and Wee, 2015). On the other hand, broadband and other internet technologies are examples of telecommunications infrastructure that offer digital connectivity for seamless integration of people, systems, as well as machines to enhance communication and collaboration (Lakuma, *et al*. 2019), therefore playing an important integration role.

2.4.2.1 *Telecommunication*

Reliable telecommunications infrastructure necessitates the establishment of a comprehensive and dependable industrial broadband infrastructure. It imposes tight standards for communication networks, and those networks must adhere to those standards and be dependable, thorough, and of the highest calibre (Lee, *et al*. 2018). Enhancing communication and cooperation between humans and machines in the 4IR depends on the integration and interoperability of cyber-physical systems. The standardisation of systems and establishment of a reference architecture are necessary for the internal (vertical integration) and external (horizontal) integration and interoperability of systems (Lee, *et al*. 2018).

At the heart of 4IR are cyber-physical systems that regulate and monitor systems, processes, use innovative information and communication technology such as robotics, sensors and advanced manufacturing techniques such as additive manufacturing through artificial intelligence and machine learning (Lee *et al*. 2018). The CPS also play an important role in integrating the real physical world with the virtual world for future development (Lee, *et al*. 2018).

Since the usage of big data through data analytics for increasing efficiency and decision making is regarded as a key feature of 4IR, CPS are a crucial technology for gaining more insights from the data to better understand customer preferences, shifting market conditions, trends, and for enhancing production efficiency (Schwab, 2018). It is anticipated that there will be a rise in the demand for workers with new capabilities and high levels of skill. Thus, the labour market is expected to undergo significant disruptions because of 4IR. A new breed of talented, creative, and tech-savvy workers is also required by the digital transformation and advances of this era (Qwerty, 2017). Consequently, the necessity to concentrate on building the so-called "future talents," some of which are yet to exist becomes urgent.

2.4.2.2 *Skills and Jobs*

Organisations, governments, and individuals must be able to anticipate and prepare for future skills requirements, job content, and the overall impact on employment to fully capitalise on the opportunities given by these trends and to prevent undesirable outcomes (World Economic Forum, 2018). Although there are concerns that 4IR would usher in robots that will replace humans, it is also anticipated to bring new challenges and opportunities that require for expertise and knowledge from people. But it can also transform humanity into a communal and moral awareness based on a shared sense of destiny as a complement to the best aspects of human nature, creativity, empathy, and stewardship. "Only one type of business will thrive in the 4IR era, a human one" (World Economic Forum, 2018). The requirement for the abilities required to recognise, design, and implement fresh and novel business opportunities presented by 4IR will be increased in creative working processes such as strategic planning, research, and development, (Sheng and Zolfagharian, 2014). To achieve this, innovative policy and legislative reforms are crucial to fostering this digital transition. They enable governments to implement policies and allocate resources in response to the opportunities and risks presented by the digital age.

2.4.2.3 *Policy and Innovation*

Innovation in the 4IR introduces new challenges such trade limitations, enterprise data security, liability concerns, and personal data privacy, which call for strict regulation through standards, laws, and policies (Lee *et al*. 2018). Policy is vital in regulating this incredibly complex smart environment (Schiuma, 2017). To help Europe through the shift, the European Commission, for instance, has created an industrial policy that speaks to 4IR. This plan is anticipated to address concerns with funding, regulatory, infrastructure, and skills issues (Schwab, 2018). Policy creates an interactive environment for “smart industries” to thrive. To support this policy, governments must create economic, industrial, and labour market policies that are responsive, equal, and capable of preparing better businesses, citizens, and government for the opportunities provided by 4IR (Baur *et al.* 2015).

This necessitates the development of innovative goods, smart services, production methods and business models that are technology driven. As a result, research and development become a significant catalyst for innovation in 4IR. In the South African context, findings through Mckinsey Global Institute study asserts that for South Africa to become a hub for global competition, the industry required to enhance its capacity for innovation (Baur and Wee, 2015). However, lack of training and investment in new technologies by organisations continue to impose hindrance to innovation (Ikuabe, Aigbavboa, Akinradewo, Adekunle and Adeniyi, 2022). As sustainability and inclusive growth receives attention, strategies should make sure that profits from the digital transformation should help society or address issues with human and developmental development, (Baldwin, 2016).

2.4.2.4 *Covid-19*

Towards the end of 2019, the world encountered what is arguably the first experience of the Covid-19 global pandemic. This threatened the entire globe in all aspects, and businesses (Dladla, 2021). Imposition of a worldwide lockdown resulted in a spike of online and virtual operation, despite resource related challenges that many businesses encountered. South Africa witnessed an increase in the introduction and utilisation of new technologies (Gregurec, Tomičić Furjan and Tomičić-Pupek, 2021). However, during this phase, they were not perceived as the infusion of innovative 4IR features, but an alternative for survival (Eggers, 2020). Even though these technologies have been regarded as important for SMEs

in the time of Covid-19 for sustainability, Manufacturing SMEs have experienced challenges in gaining government support towards their utilization (Ntuli, 2022).

2.4.3 Opportunities and Threats of the 4th Industrial Revolution

2.4.3.1 Opportunities

2.4.3.1.1 Productivity

According to Kim *et al*. 2018, the common factor across all industrial revolutions and ages of civilization has always been an increase in productivity. This is the case with 4IR. In general, technology differs from conventional production inputs such as, raw material, land and building or labour since it has non-exclusive, rapid diffusion features that boost productivity. (Guoping *et al*. 2017). To confirm this, 4IR technologies, by definition also regard productivity enhancement as a common objective. Therefore, integrating new technologies with a lean value stream designs also aids in overcoming current obstacles and lead businesses to improve productivity (Pradhan, Macias de Anda, Martinez, Sawhney and Kumar, 2020). Gains in productivity and efficiency develop new markets and stimulate the economy. (Lee, Yun, Pyka, Won, Kodama, Schiuma, Park, Jeon, Park, Jung, Yan, Lee and Zhao, 2018).

2.4.3.1.2 Growth and Development.

In fighting exclusivity, 4IR offers, among other provisions, a greater opportunity for growth across industries through globalisation and collaborative partnership in digital economy (Kayembe *et al*. 2019). Through this, by 2017, businesses in countries such as Romania were able to increase production significantly and reduce costs by 25% (Stancioiu, 2017). According to Carvalho, Chaima, Cazarinia and Gerolamo (2018), 4IR, through its range of network and virtually interconnected manufacturing technologies provide significant aspects of development that respond in real time to the internal and external demands of production processes. Virtualisation, digitisation and integration increases sustainability awareness (Carvalho *et al*. 2018), a critical component of growth and development in manufacturing.

2.4.3.1.3 Improve Standard of Life

Another benefit that is expected from this revolution is the improvement of the standard of living, through these innovative technologies (Schwab, 2015). According to Min Xu *et al.* (2018), artificial intelligence possesses the potential to improve our standard and quality of our life in our home, work, etc. When comparing 4IR with the first three, it is most significant single development in human history (Stearns, 2018).

4IR is argued to be a significant development, transition, or transformation in the history of human society, considering the use of machines, telecommunications, and electricity, to new advances in the form of technology (Kayembe *et al*. 2019).

2.4.3.2 Threats

2.4.3.2.1 *Social Challenges*

The 4IR has its share of challenges. For instance, major obstacles associated with 4IR have been recognised in Europe as the need for investment, changing business models, data issues, legal questions of liability and intellectual property, standards, and skills mismatches (Lee *et al*. 2018). Germany is another example where societal challenges such as job loss and rising societal instability have also increased their manufacturing sector, resulting from 4IR techniques (Lakuma, Marty and Muhumuza, 2019). In South Africa, these challenges are exacerbated by the fact that governments are already struggling to curb social ills such as inequality and a high unemployment rate (Qwerty, 2017). Subsequently, inequality overlaps to the cost and accessibility of these modern technologies. Another challenge that is tied directly to the adoption of 4IR is the mismatch of skills and the redundancy of skills, caused by the changing nature of work because of technological and manufacturing advancements (Ku and Chen, 2016).

2.4.3.2.2 Infrastructure

In addition to societal issues, emerging economies also face infrastructure and technology challenges. If China, a developed state with a sophisticated infrastructure, encounters difficulties when introducing new technologies like analytics, network development, and smart devices (Lai, 2018), the severity of such challenges in countries like South Africa, with less related infrastructure can be expected to be higher. These challenges are at an even higher rate in developing countries that are less advanced when it comes to technological and

infrastructure development. Poor ICT infrastructure in developing countries is thus one of the main obstacles that governments encounter in their bid to implement 4IR (Lai, 2018). To further illustrate this, broadband penetration in developing countries is still low when compared to industrialised economies, who are leaders in broadband and other ICT infrastructure (Schwab, 2018). One of the barriers of transition to the so-called smart society in South Africa is country's low broadband penetration (Qwerty, 2017). In addition to technological and infrastructural challenges is data privacy and security-related issues. This has become one of the biggest challenges in of 4IR, where technology has the driver of adoption (Lai, 2018).

Integration of systems in 4IR requires the creation of new security and protection strategies for collaborative value networks and smart production systems that are faster and more flexible (Lee *et al*. 2018). Moreover, new difficulties in respect of data privacy and protection are going to emerge as a consequence of the increased usage of data analytics (Baldwin, 2016). Lastly, in the age of the "smart", concerns about security and privacy in technology raise trust challenges (Jaafar *et al*. 2017).

2.4.3.2.3 Policy Development

Some of the concerns that modern societies are still struggling with could not be addressed by the previous three industrial revolutions and the policies that went along with them. These include inequality and climate change (Morrar *et al*. 2017). For this reason, it is therefore critical for 4IR policy makers to be mindful of these existing threats when developing new policies to cater for potential social problems. Skills, innovation systems, and knowledge networks are expected to provide intellectual guidance to the development and implementation of smart and digital initiatives (Sheng *et al*. 2014). In addition to research and development, sharing knowledge that integrate the society at large should be the starting point of smart and digital initiatives.

This should include citizens, government, small businesses, and big corporates. The success of the so-called "smart society" has been associated to e-readiness (e-skills and e-literacy) (Kodama *et al*. 2015). Additionally, the citizens' capability to fully participate in social and economic activities in the smart society is influenced by their level of e-readiness (e-literacy

and e-skills) (Kodama *et al*. 2015). Low levels of e-readiness in developing nations like South Africa have been mentioned as a barrier to the transition to smart societies (Lai, 2018).

2.5 Small and Medium Enterprises

SMEs play a significant role in creating jobs (Almeida and Aterido, 2019). Thus, an insight into the determinants of enterprise growth and sustainability are important from a policy perspective (Aterido, Hallward-Driemeier and Pages, 2019). The factors that impact an enterprise's growth are categorised as either external or internal to the business. The significance of SMEs to the economies of emerging economies has long been acknowledged by the international community (Aulakh, Kotabe and Teegen, 2018). Globally, they are recognised as an opportunity for both developed and developing countries to enhance their economic prosperity, through improving their participation in the global trade (Chong *et al*. 2019). Hence their importance throughout the developing world is undeniable. For these reasons, policy makers across the globe distress about how to foster productivity, growth, and sustainability among this group of firms.

However, they are confronted by many barriers to growth and sustainability when compared large companies. Access to finance commonly ranks highly among these constraints and is frequently seen as the main cause of SMEs' lower capacity for investment. Therefore, it is vital for the construction of policies that support long-term productivity and growth (Beck and Demirguc-Kint, 2016). To elaborate further on technological advances, this entails the discovery of new techniques as well as the improvement of existing techniques that are used. According to the two theories used for this study, technical advancement is a prerequisite for the expansion and sustainability of a certain economic sector, the entire economy as well as the generation of social benefits from economic growth. Thus, technological advancement is one of the theoretically acknowledged methods for removing an economy's frontier barrier, due to its' ability to increase the productivity and efficiency of the economy's factors of production such as, labour, capital, raw material (Armario, Ruiz and Armario, 2018).

Technological advancement is also a process of invention and innovation in the economy, where invention refers to the scientific advancements needed to modernise the economic production system and innovation denotes the application of new scientific discoveries for the output's commercial purpose. (Bernard, Jensen, Redding and Schott, 2012). On the other

hand, the world economy is becoming ever more integrated because of technological improvements, falling barriers to trade, and other negative factors.

This swift globalisation makes it possible for SMEs to expand internationally in a quick and efficient way (Berringer *et al*. 2018). It is therefore argued that South African SMEs should concentrate on the critical success factors referred to as competitive assets and competences. These factors will enable them to compete successfully within a given market, in addition to looking for funding for the start-up and growth of their entrepreneurial business. In addition, the clear majority of South African SMEs could increase their prospects of competing internationally if they received sound business support and development services in addition to funding (Berringer *et al*. 2018).

There is enough solid evidence from significant results to demonstrate that the new knowledge economy depends heavily on innovation. This has emerged as a key concern for economic growth, sustainability, and business success in the new global economy (Lin, 2018). Innovations now begin with the creation of new knowledge, which is something that an inventive organisation can do. Hence, barriers to collaboration are being removed by an increasing interest in finding new sources of information for innovation, offering an alternative to the old, closed perspective of research and development (R&D). Even though there are numerous studies on major company collaboration and open innovation (OI), there is still a deficiency of study on SMEs in the context of 4IR (Wentzel *et al*. 2013). Despite the above-stated limitations, SMEs may still benefit indirectly from exports if they serve as suppliers to bigger businesses.

For this reason, new perspectives on how SMEs and major corporations contribute to the economy are valued by policymakers and used as a foundation for future decisions. SMEs account for a sizable portion of the labour force and provide a significant portion of value added, but they are less connected to foreign markets than larger businesses are (Yang *et al*. 2019). Even though, at an individual level, entrepreneurship have gained momentum as a key driver of sustainable economic growth. These positive economic contributions do not come without challenges. Lack of financial inclusion, the strictest laws and regulations, and the worst infrastructure, remain common challenges facing entrepreneurs in sub-Saharan Africa (Berringer *et al*. 2018). Small markets and a lack of thorough entrepreneurship training

have both been identified as major obstacles for regional entrepreneurs (Osano, 2019).

This is another obstacle for education and training in the 4IR era, particularly since knowledge communities are vital participants in providing the crucial intellectual direction for the creation and implementation of smart and digital initiatives (Sheng *et al*. 2014).

2.6 The interdependence between 4IR and Manufacturing SMEs

SMEs continue to be significant and critical, depending on how they successfully and efficiently use these technologies (Osano, 2019). They have emerged in recent years through continuous technological advancements and have begun to thrive even in this highly competitive industry. The significance of technological development capability, as an intangible asset has been emphasised to overcome a complex and continuously changing environment. Thus, SMEs and the current 4IR age are interdependent. The core competency and competitive edge for small businesses therefore depends on the capability to acquire, choose, and use technology (Bernard *et al*. 2012).

As technological creation competence is a complicated and implicit 4IR feature, it might deter rival imitation and foster SME expansion. Another element of 4IR, digitalisation, has an impact on the consumer sector in ways that were unthinkable a generation ago. The world is currently experiencing a revolution that expands upon the electronic, computing, and information technology of the Third Industrial Revolution. This incorporates both new and old technologies an (Schwab, 2018). Existing products are being replaced by new products, often with digital and artificial content. For instance, vinyl records were beloved by many and even managed to maintain a (increasing) niche market, but most customers today take advantage of subscriptions to cloud services that provide access to music catalogues on demand on a scale that they could never afford to buy. (Schwab, 2018). Traditional maps are being replaced by online App services that are even available immediately via mobile phones (Lee, 2017).

Alongside all these positive developments, digitalisation is provoking major disruptive effects in the consumer marketplace for SMEs. It opens a room for new ideas to be spread to broader markets and at a faster pace when compared with new business ideas that were developed and introduced during the era of the other three industrial revolutions. While consumers are now embracing new prospects, others could also feel insecure as they struggle with the usage and purchasing of new products.

The significant value of this study would be to highlight the fact that technological advancement need not obstruct the adoption of 4IR among manufacturing SMEs in KZN. Since there has been little economic growth globally and thus less demand, corporate management has come under threat. In this era, the convergence of new technologies is driving social system structural change and generating new markets and demands (Lin, Shih and Sher, 2017). Thus, during this 4IR era, a lot of SMEs are attempting to pivot globally. This could help to alleviate the current global economic challenges (Osano, 2019). Our current technology revolution is the source of 4IR, which will inevitably have an impact on industry and the structure of the global economy (Berringer *et al*. 2018).

Emerging technologies will radically alter how goods and services are delivered, shattering current industrial value chains in the process (Lee *et al*. 2011). Therefore, 4IR will generate new markets, new demand, new supply, and new value because the trend's core is technology-enabled platforms that disrupt current industry structures (Lee *et al*. 2011). The notion of 4IR can be introduced based on the availability of 4IR and the order in which it is composed (Lee, 2017). However, estimating the certainty of its order of the concept is based on the 4IR controversy's instigation (Li, 2017). Even though this revolution has been underway since the dawn of the twenty-first century, it is a radical transformation marked by cutting edge innovations like the pervasive and mobile internet, less expensive, more powerful sensors, and synthetic machine learning (Schwab, 2018). 4IR is the revolutionary change that happens as new technologies and IT become prevalent throughout all industries, including the primary, secondary, and tertiary ones. In other words, it is the outcome of the introduction of new technologies and the horizontal spread of IT. Considering these, the 4IR emphasises the innovative connection of technology and the market in all IT-based industries such as the innovative and open connection of technology and the market through open innovation, or growth based on new open business models (Lee, 2017).

2.7 Conceptual Framework

The theories, their associated hypotheses, operationally defined variables, and concepts used to evaluate the impact of 4IR on manufacturing SMEs make up the conceptual framework. The Technology Readiness Model and the Opportunity Based Theory of Entrepreneurship served as models and guiding principles for this study. In the framework of 4IR, it also discusses the South African economy and Small and Medium Enterprises.

The literature review and the conceptual model are included for creativity and invention. These discoveries and developments gradually change how SMEs and big corporations operate, how they affect society, how they leave an ecological footprint, and how people live their lives. They involve the creation, use, and exploitation of both new and old technology. However, the creative traits of organisation have a significant impact on their beginnings and development. The aspirations, curiosities, creativity, expertise, and passion of those who have imagined, prototyped, and tested a technology are always at the heart of its development.

The presence of both firm capabilities characterised by optimism, innovativeness, discomfort, and insecurities, as well as market opportunities resulting from 4IR, enhances the entrepreneurial decision to pursue an opportunity.

Figure 2.3.3: 4IR and SMEs in Durban

Source: Author's own compilation

The definition of construct technology readiness, which is on a par with ready for new technologies, is "people's inclination to embrace and apply new technologies for accomplishing goals in home life and at work (Parasuraman, 2000). The model can be viewed in the following aspects.

Optimism: A positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives.

Innovativeness: A tendency to be a technology pioneer and thought leader.

Discomfort: A perceived lack of control over technology and a feeling of being overwhelmed by it.

Insecurity: Distrust of technology and scepticism about its ability to work properly.

The writer envisions optimism and innovativeness as positive drivers of technology readiness, while discomfort and insecurity would serve as inhibitors. In this regard, thus the first statistical inquiry involves assessing the generalisability of Ling *et al.* (2018)'s technology readiness model and the opportunity-based theory of entrepreneurship specific to manufacturing SMEs in KwaZulu-Natal. The last variable in the framework looks at the impact of 4IR, being the key concept encapsulated in the conceptual framework. One notable feature of 4IR, particularly in manufacturing industry is digitalisation as a cost saving strategy that is anticipated to enhance competitiveness in future (Alexander, 2022). This has opened the door for innovation opportunities such as self-designed products and the freedom to be very creative in their offerings (Alexander, 2022). As a result, many countries around the world, particularly those in the first world, have introduced policies to boost investment to encourage intelligent manufacturing and work toward the transformation and modernisation of their manufacturing sectors. South Africa is not an exception, being a significant manufacturing country in the globe and where manufacturing and SMEs are essential to its economy.

2.8 Conclusion

This chapter explored approaches, concepts, and literature that relate to the South African economy and entrepreneurship, SMEs, manufacturing SMEs, 4IR, and provides a detailed assessment of the South African economy from the time of its independence, 1994, until to-date. The in-depth review was critically guided by the theoretical frameworks that explore the concept of 4IR, perception, and awareness based on the Technology Readiness Model and Opportunity-Based Theory, to successfully achieve the main objectives of this study. It is ascertained that during the era of 4IR, existing and new anticipated "normal" is assessed on how it influences the globe economically.

The literature has also subsequently revealed that during this era, new technologies are seen to have critical impact on manufacturing, and trading. These new technologies bring about both opportunities and threats to all stakeholders, namely, businesses, consumers, government, and the citizens at large. Theories that relate to entrepreneurship and technology, and their application to this study also indicate the extent in which socio-economic impact of 4IR affects these stakeholders differently. Although the fourth industrial revolution continues to introduce itself as a surprise package, the response to it must integrate and comprehensively involve all stakeholders, from the public to private sectors and academic society from local up to the global level. Critically identifying the implications that surfaces within SMEs in the manufacturing sector during this era becomes paramount.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The overall purpose of this chapter is to explain in detail the research paradigm, targeted population, sampling method, data collection and analysis techniques employed in this study. The main points of focus are the description of the interview schedule, the test of data quality, the scope of the study, targeted population, sample selection, sample size, distinction between qualitative and quantitative research, interview design, validation of interview results, ethical consideration and how they were handled, to ensure the validity and reliability of data.

Research methodology outlines a systematic approach carried out to investigate a research problem and the rationale for the employment of methods or techniques to locate, pick, analyse, and interpret data utilised to comprehend the problem (Ibrahim, 2017, Kallet, 2019). It is a scientific procedural framework on how the research is to be conducted (Rajasekar, Philominathan and Chinnathambim, 2014; Ibrahim, 2017), and a study of methods utilised by researchers to describe, explain and predict, to gain knowledge and work plan of the research. Following a qualitative design, this chapter further outlines the research design for the collection, measuring, and analysing data to answer research questions (Sekaran and Bougie, 2016) as well as the research paradigm (Adedoyin, 2020). The research paradigm used in this study was the exploratory described as the method that identifies key issues, variables and greater understanding of their occurrence (Kobus, Creswell, Ebersohn, Eloff, Ferreira, Ivankova, and Nieuwehnuis, 2016).

Data was collected through interviews. This enabled the researcher to effectively engage with the respondents. This research was undertaken to gather knowledge about 4IR, and the field of entrepreneurship, manufacturing SMEs. The aim of this study is to assess the impact of the 4IR on manufacturing SMEs in Durban, KwaZulu-Natal, to ascertain their awareness levels, factors that influence their awareness levels, factors that influence perceptions, technology awareness levels and the general perception of respondents.

3.2 Research Paradigm

The key pillars of a research and its methodology is the adopted and applied research paradigm. Defined in research context by Kivunja and Kuyini (2017), this is a set of shared beliefs that guides the meaning or interpretation of research data, research paradigm directly and scientifically influences how the researcher understands and addresses the problem, as detailed in research questions. A research paradigm must mutually include interrelated beliefs that define the nature of the along these three dimensions (Moon and Blackman, 2017). These beliefs are systematically encompassed on three interrelated philosophical foundations or research paradigms, namely ontology, epistemology and methodology.

Ontology is the science or study of existence (Blaikie, 1993). This description was created for the social sciences to include "claims" about what exists, what it looks like specifically, what components make it up, and how these components interact with one another. Ontology, however, is a description of a person's perspective (whether assumptions or claims) on the nature of reality, broadening the conversation to include how people and groups come to these conclusions. Reality does exist under this paradigm (Ibrahim, 2017; Kamal, 2019). It is discovered in the research through strengthening the theory, and by removing alternative descriptions.

The second paradigm is **epistemology**. Derived from a Greek term “episteme” that means knowledge, this philosophical term, epistemology is used in research to describe how something becomes known, how the realty is defined and what is referred to as knowledge within the world. It focuses on the types of human knowledge and understanding that a researcher can best acquire, use, extend, broaden, and deepen in the research field to provide an in-depth analysis of the circumstances under which a belief can achieve a desired epistemic state (Kivunja *et al*. 2017; Goldman and Beddor, 2021). What connection exists between the researcher, who is the questioner, and the known? Furthermore, it helps the researcher to develop the faith in data (Kivunja *et al*. 2017; Stroll, 2022). In epistemology, positivism, as one of its components is attained by the researcher's impartiality, preventing the researcher's personal ideologies from impacting the study (Ibrahim, 2017; Kamal, 2019). Interpretivism is another component of epistemology. It states that the researcher and reality are interdependent. Furthermore, it asserts that are created by human beings, therefore making it impossible for research to be value-free (Ibrahim, 2017; Kamal, 2019).

Lastly, **methodology** refers to a systematic design, approaches and procedures used to outline the method used in conducting the investigation (Antwi and Hamza, 2015; Ibrahim, 2017). This entails outlining the purpose and direction of the systematic steps taken throughout the research project, such as gathering the appropriate data, and analysing it to provide a correct response to research questions and subsequently advance knowledge (Kamal, 2019). It also addresses inter-related questions on what can be sought (the ontological position), what can be known and discovered (the epistemological position), and how to go about obtaining it (the methodological approach) (Moon *et al*. 2017). This can be conducted in either a deductive or inductive approach. Defined by Kamal (2019) and Ibrahim (2017), as components of methodology, deductive approaches starts with theory and then follow up with hypothesis. An inductive approach on the other hand develops theory through analysis and exploration.

3.2.1 Research Design

A research design is the strategy outlining how, when, and where data will be gathered and analysed (Creswell and Creswell, 2017). It gives direction and systemises scientific research. It structures comprehensive investigation to attain answers to research questions or problems (Kumar, 2011), to create a framework that promotes systematic management of data collecting and provides valid, honest, accurate, and economical responses to questions (Sileyew, 2019). There are three basic types of research designs, qualitative design, quantitative design, and mixed method design. The choice of the research design to be used in a study depends on the nature of the research and the framework of the research project (Asenahabi, 2019; Sileyew, 2019).

A qualitative approach enhances the researcher's understanding of the world, the inter-subjective behaviours, and perspectives of humans, through studying their actions, beliefs, attitudes within the context of the study (Silverman, 2016; Gibbs, 2018).It aims to comprehend phenomena in their natural environments, arranges patterns from responses, tries to interpret and make sense of these phenomena in light of the meaning that humans assign to them (Leung, 2015). Concepts and meanings in this approach use techniques for collecting data through in-depth interviews, focus groups, and outside observation (Eyisi, 2016; Bernard, 2017).

Quantitative approach on the other hand uses statistical data to develop a hypothesis and tests it through “mathematically-based” methods for better understanding (Daniel, 2016). It induces events in controlled settings and separates the crucial factors that cause a phenomenon. It also draws inferences regarding observations to the broader population from a non-biased sample. (Almalki, 2016).

Lastly, the mixed methods design combines both the quantitative and qualitative approaches into single use, usually in complex research that require both raw and secondary data (Daniel, 2016). This allows the researcher to use qualitative and quantitative instruments for the collection of data (Creswell *et al*. 2017).

A qualitative research approach was also chosen, and data was gathered using structured interviews with open-ended questions. Defined as a directed and meaningful conversation between two or more people (Sekaran *et al.* 2016), open-ended questions were used to accommodate more meaningful answers from the participants during the process and enable the researcher to probe more information. This method was deemed suitable for the research due its advantages such as nature of flexibility and free from rigid boundaries, and its ability to provide the relationship of comprehensive information with research results (Kumar, 2014; Rahman, 2017). In addition, this approach allows flexibility of the research design to be constructed and reconstructed to a greater extent. Thus, enabling participants have enough freedom to determine what is consistent for them. As a result, the complex issues can be understood easily (Kumar, 2014; Rahman, 2017).

Lastly, this approach, through its exploratory nature will explore in-depth concept of 4IR among manufacturing SMEs. Being extensively involved in people's societal relationships is the best approach to comprehend why they act the way they do (Wilson, 2019; McMillan and Schumacher, 2020).

3.3 Targeted population and sampling method

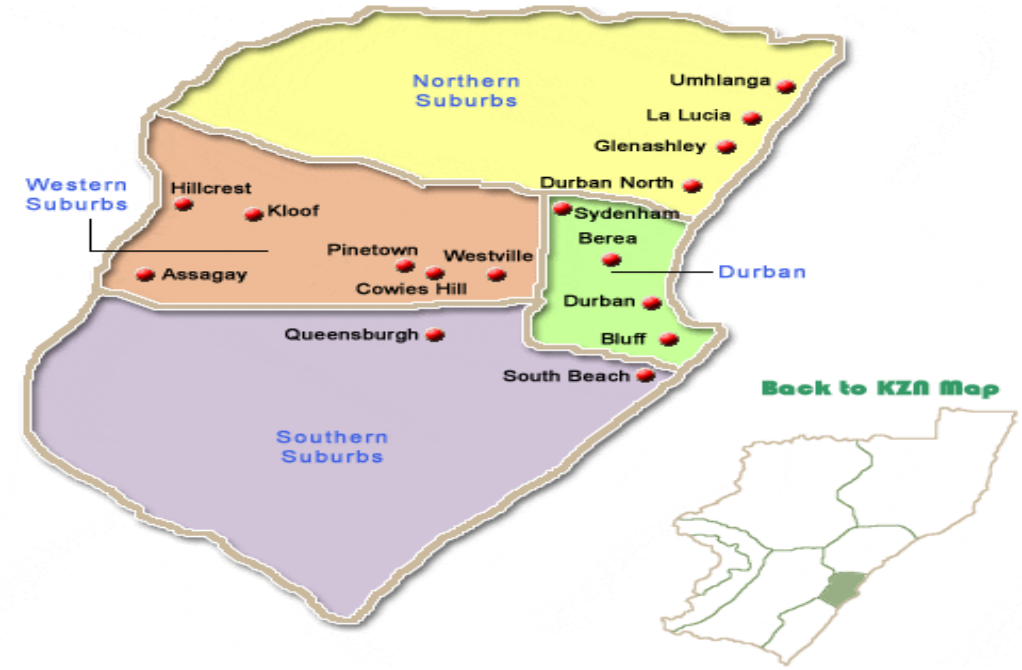
The target population is a collection of elements (people or things) that share a specific trait as determined by the researcher's sample criteria (Patel, 2018). For this study, the population is small and medium manufacturing enterprises that are based in Durban, KwaZulu Natal, South Africa. The manufacturing SMEs in Durban are estimated to be around 2,150 (Gwala,

2014). SMEs are categorised as follows. Eleven to fifty employees (Small enterprise), fifty-one to two hundred employees (Medium enterprise). Sampling is a selection of a smaller group of individuals or items from the available population using a specific technique to be part of the research (Creswell *et al*. 2017). There are two general types of sampling models, probability and non-probability sampling.

Probability sampling model utilises techniques such as systematic, random sampling, and stratified random sampling that grants equal probability of selection into the sample to every unit in the population (Gray, 2014; Sharma, 2017). Non-probability sampling model selects samples based on the researcher's subjective evaluation. It uses techniques such as quota, purposive, snowball, and convenience sampling (Sekaran *et al*. 2016; Struwig and Stead, 2015). The non-probability technique used for this study was a snowball sampling technique, due to its ability to accommodate referrals by participants to others who they deem suitable for participation (Cilliers, Davis, and Bezuidenhout, 2014). A smaller portion of the population was chosen to generalise the results to the entire population because this study involved a big population that could not be studied in its entirety.

3.3.1 The Research Study site

The study was conducted in KZN, within the vicinity of Durban city under eThekwini Municipality. It is the third most populous city in South Africa and the largest city in the South African province of Kwa-Zulu Natal, with a population of about 3.9 million (Global Future Cities Programme, 2021). Beyond being well known as one of the busiest ports in the country, it is also seen as a major centre of tourism, and the second most important manufacturing hub in South Africa (Global Future Cities Programme, 2021). The manufacturing industry contributes about 20% GVA to the economy of the city, a significant contribution towards making Durban an economic backbone of KZN (District Economic Profiles, 2021). The targeted population is owners or managers of manufacturing small and medium enterprises.
Figure 3.4: Map of Durban



Source: Durban Map Search

Referring to the map above (Figure 3.4), Durban is divided into four functional municipal planning regions (MPRs), namely, the North, South, Outer West and Central. The central MPR is the core of industries, with manufacturing major economic sectors and hubs such as industrial (District Economic Profiles, 2021).

3.4 Sample Size

A sample of 15-20 is a recommended sample size for qualitative studies to reach saturation point (Dworkin, 2012). This is the point at which there is no longer a possibility of obtaining fresh knowledge or enough data to repeat the analysis (Fusch and Ness, 2015). Even though a sample size of 40 participants from small and medium businesses respectively was deemed sufficient. However, data saturation was reached after interviewing 11 small enterprises and 9 medium enterprises. In total, 20 business owners/managers were interviews. In the event where owners were not available, managers were interviewed.

3.5 Data Collection Technique

In qualitative research, data is collected though a structured interview, observations, discussions, which provides researchers with rich insights to systematically analyse data to enhance detailed understanding (Barrett and Twycross, 2018). For the purposes of this study,

data will be collected through structured interviews. Defined as a guided, purposeful conversation between two or more people open-ended questions will be used to accommodate more meaningful answers from the participants during the process (Sekaran and Bougie, 2016). It will also be relevant for the research because of flexibility, in-depth in their search, free from rigid boundaries which afford the researcher liberty to probe more information (Kumar, 2014).

Communication highlighting the purpose of the study will accompany an interview guide and the participant's consent form. This approach will be useful for this type of study in gathering thorough information about individual thoughts, feelings, and opinions. It will also make it possible to ask more in-depth inquiries (Saunders *et al*. 2017) and clarify ambiguities and follow up on partial responses.

3.6 Description of The Interview Schedule

The researcher introduced himself and gave a brief description of the study's and interview's objectives to gain consent. The approval of conducting such a study within the organisation were sought from all appropriate authorities of interviewed SMEs. Appointment were made by the researcher to do the study. The equipment was physically distributed to the SMEs by the researcher. Participants were informed that their answers and the data gathered will be kept secure and only the researcher will have access to them. The participants were made of their rights to leave the interview at any time for any reason. There were no consequences for withdrawing from the interview. Setting the Voice recorder: Where interviews were conducted virtually, by reviewed meeting policies and procedure by businesses due to the Covid-19 pandemic, the researcher also informed the participant that the interview would be recorded. After receiving consent, the interviewer proceeded with the interview. The research instrument can be found in Annexure B.

3.7 The Test of data quality

3.7.1 Pilot study and test of the research instrument

The interview guide's items were evaluated for validity and reliability before the study was conducted. A pilot study is a small-scale study done in advance of a significant study (Polit

and Beck, 2019) conducted to test study protocols, validating tools, estimating the recruitment rate, and estimating characteristics like the variance of the outcome variable to determine sample size (Arain, Campbell, Cooper and Lancaster, 2020). This is the process whereby a practical test of the study is conducted, preparing of a full-scale study and may be conducted specifically to pre-detect ambiguity and possible faults in the measuring instrument and whether concepts have been adequately operationalised (Dikko, 2016). The that the participants found two interview questions to be ambiguous. These two questions were rectified.

3.8 Data analysis

Quantitative and qualitative data analysis must both systematically utilise statistical (Msomi, 2020). Interviews focus groups and observation are core systematic data collection in qualitative research that provide researchers with rich insights and allows for the development of detailed understanding Systematic data (Barrett *et al*. 2018). To this research, data collected through interviews was coded and then analysed using the content analysis technique. Content analysis is a data analysing technique that enables the researcher to collect and analyse factual data and understand it (Cillier *et al*. 2014). This form of analysis involves systematically evaluating texts to produce underlying patterns in the dataset. These patterns that emerge from the analyses will, represent the most common sentiments shared by the participants. A data analysing tool to be used in this study will be NVivo. This software enabled the researcher to simplify data management, coding procedures, modelling visually, data queries and ideas (Hamed, Saleh and Alabri, 2013).

3.9 Test of validity and reliability of the study

Validity is a test on the consistency throughout the research project that determines the trustworthiness of the findings from the standpoint of the researcher, the contributors, and consumers of the research (Senkaran et al. 2016, Rose and Johnson, 2020). It measures the suitability of tools, process and data. Furthermore, it measures the legitimacy of research question and chosen methodology for the desire outcome, the appropriateness of the methodology, design for answering the research question and sampling data analysis. Lastly, is also tests if the results and conclusions are valid for the sample and context (Kumar 2014; Leung, 2015; Rose and Johnson, 2020). Reliability on the other hand serves as a measurement tool for the quality and goodness of an analysis, consistently with four factors

that are closely related to validity and reliability which are credibility, transferability, dependability, and conformability (Leung, 2015). To ensure validity and practical reliability, accurate methods and standard conditions were maintained throughout the project, consistently with applied analytical procedures when collecting data, coding, analysing and presenting it.

3.10 Ethical consideration

The norms or standards of behaviour that provide a distinction between right and wrong are known as ethics. They aid in defining what acceptable and inappropriate behaviour is. As a piece of science, this study followed all ethical standards. Consequently, the following issues were taken into consideration.

3.10.1 Request Authority from relevant authorities

For permission to conduct the study, an ethical clearance certificate was obtained from the SMEs, the Durban University of Technology Ethics Committee, and the study participants. Furthermore, the gatekeeper's letter was given for the study and that DUT research protocols were followed.

3.10.2 Informed Consent

The permission to engage in research after learning about the study, including potential risks and benefits, is known as informed consent. This suggests that the participants must be aware of the research's objectives and how their participation will benefit them. When a person gives informed consent, they are agreeing to engage in research after learning about the study's potential risks and rewards. This suggests that the participants must be aware of what the research involves and how they will profit from it (Taylor *et al*. 2018). The study's volunteers will have enough time to weigh the advantages and disadvantages of taking part in the study before making a voluntary decision to participate. Participants will also be made aware of all the study's advantages and disadvantages.

3.10.3 Privacy and Confidentiality

While privacy relates to people and their interest in restricting access to themselves, confidentiality refers to the security of the information about the person that has been disclosed to the researcher (Sieber, 2018). Since enterprise information is private, the

researcher shall uphold the greatest standards of confidentiality. Owners' and managers' opinions will be safeguarded, and their identities will be kept secret.

3.10.4 Anonymity

In research, anonymity is typically extended to mean that the researcher does not include information about any individual or research site that would allow that individual or research site to be identified by others (Walford, 2015). On the interview guides for the study, numbers rather than participant names will be utilised. If the participants requested it, the researcher will also need to get the university's permission to make the material public.

3.11 Limitations

Limitations were evident on the basis that there are small and medium manufacturing enterprises operating in Durban, but their sector did not have representation from which data will be collected. Moreover, the researcher was not able to acquire enough information when comparing different small businesses in different regions of KwaZulu Natal or provinces, therefore was not able to generalise the findings beyond the scope of this study.

3.12 Conclusion

In summary, the information in this chapter has covered the research paradigm, research design, the target population, the selection process for the sample selected from the target population, collection and analysis techniques, and ethical consideration. While research methodology referred specifically to the selection of the precise research methods that are available to the researcher for the gathering and analysis of data, research design serves as the foundation upon which a research question is built. For this study, a qualitative design was used due to its nature of flexibility, in-depth in their search and free from rigid boundaries and the goals it aimed to achieve. A total sample size of 20 participants each from small and medium businesses respectively were interviewed.

Eleven small enterprises and nine medium-size enterprises. Data was collected through structured interviews that guided a purposeful conversation between the interviewer and the interviewee. Open-ended questions were used to accommodate meaningful answers from the participants during this process. Each of the research objectives served as the foundation for each of the study's questions. A data analysing tool NVivo was used to systematically

evaluate write-ups and produced underlying patterns from participants. Additionally, this chapter covered topics including the test of validity and reliability of the study.

Ethically, an ethical clearance certificate was obtained from the Durban University of Technology Ethics Committee, and eThekwini Municipality. Informed consent was given by participants, who participated on an anonymity basis. This study was limited to manufacturing SMEs with a base in Durban and delimited to a maximum of 40 owners of Durban-based manufacturing SMEs.

Findings are presented and analysed in the next chapter.

CHAPTER 4

ANALYSIS, FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents an analysis and discussion of the data collected for the study. The interview questions used were framed to elicit information from participants on the level of awareness of the 4IR and its implications among manufacturing SMEs owners and managers in Durban, KZN province. Data was collected from 20 respondents as saturation was reached at that point. The interviews were transcribed and analysed qualitatively, with the aid of NVivo 12 software. The study used content analysis because it is systematic, flexible, and capable of refining data into easily understandable themes and sub-themes.

4.2 Biographical Information of Interviewed Owners and Workers

The researcher interviewed 20 SMEs in Durban, South Africa. Keeping with the anonymity of the participants, the interviewees were represented with an assigned code. This assisted the researcher in easily recognising the participants and their responses, while also maintaining confidentiality and anonymity for purposes of ethical considerations. During the analysis phase, information gathered from structured interviews was verbatim transcribed, and pertinent quotes from this data were used to support the discussion on themes. To protect their anonymity, the study does not disclose the identities of the main informants. Table 4.1 below highlights the terms used to describe them in the study.

The data in Table 4.1 further illustrates the biographical information of the participants. Even though 8 of our participants are in their thirties, they have an average age of 41 years, ranging between 29 years and 56 years. While 6 of the respondents did not disclose years of experience in their roles, the remaining 14 of the participants have an average of 8 years and 6 months of experience, ranging between 3 years and 15 years. Males constituted 65% while 35% were females.

`Participant	Business Category	Position and nature of business	Age (Years)	Education qualification	Gender	Work duration (Yrs)
P1	Wood Production	Business owner	56	Matric	Male	N/A
P2	Toiletries	Management	41	Degree	Female	10
P3	Apparel	Management	33	Diploma	Female	5
P4	Medical	Management	39	Degree	Female	N/A
P5	Computer parts	Management	47	Matric	Male	N/A
P6	Beds and mattresses	Management	30	College Qualification	Male	3
P7	Equipment	Management	49	N/A	Male	N/A
P8	Glasses and windows	Management	38	Degree	Male	6
P9	Packaging	Management	52	Degree	Male	10
P10	Chilli sources	Business owner		Matric	Male	N/A
P11	Paper	Management	43	Degree	Male	N/A
P12	Equipment	Management	39	Diploma	Female	5
P13	Car Accessories	Management	29	Diploma	Male	10
P14	Clothing	Management	49	Degree	Male	15
P15	Candles	Management	28	Degree	Female	5
P16	Car parts	Management	55	Degree	Male	20
P17	Kitchenware	Management	34	Master-MBA	Female	7
P18	Stationery	Management	31	Diploma	Male	4
P19	Beds and mattresses	Management	48	Technical Qualification	Male	10
P20	Toiletries	Business owner	39	Degree	Female	11

Table 4.1: Participants' Biographical Information

In terms of educational status, 15% have grade 12 qualification, 20% hold undergraduate qualifications (diploma), 40% holds undergraduate qualifications (degree), whereas only 1 person holds a post-graduate qualification (MBA).

4.3 Emerging Themes

Themes were identified in line with and linked back to research objectives (Chapter 1 section 1.4). As indicated, there are four objectives and the themes pertaining to each individual objective are as follows:

Objective 1: To ascertain the level of awareness of 4IR among manufacturing SMEs in Durban, KZN.

Themes:

Enhanced and connected system

Improvement of business processes

Growth and transformation

Objective 2: To determine factors that influence the awareness of 4IR among manufacturing SMEs in Durban, KZN.

Themes:

4IR utilisation drivers

Risks and opportunities of 4IR

Objective 3: To ascertain the level of technology acceptance among manufacturing SMEs in Durban, KZN.

Themes:

Progressive work environment

Getting familiar with new technology

Alignment of purpose to digital age

Objective 4: To identify the general perception of 4IR among manufacturing SMEs in Durban, KZN.

Themes:

Expectations from 4IR

The themes mentioned above have their corresponding sub-themes and these are all discussed in detail in the ensuing sections.

4.4 Themes and sub-themes for Objective 1: Ascertaining the level of awareness of 4IR among manufacturing SMEs

As observed in section 4.3, themes 1 to 3 pertain to objective 1. These themes and their sub-themes are presented below in table 4.2.

Table 4.2**: Identification of themes and sub-themes for Objective 1**

Theme	Sub-themes
1. Enhanced and connected system.	-Connection of digital, technological and physical world. -An integrated system, building on the old revolutions.
2. Improvement of business processes.	-Modernisation of production. -Improve productivity. -New innovations. -Improves business value chain. -Competitive advantage. -Upskilling and knowledge development. -Reduction of workload. -Promote satisfaction.
3. Growth and transformation.	-Placing business on the map. -Growth of economy. -Promote change and transformation.

4.4.1 Theme 1: Enhanced and connected system

In pursuit of evaluating the level of awareness of 4IR in line with the first objective of this study, participants share their perception. Emerging views from participants collectively defined 4IR as the connection of digital, technological, and physical worlds.

The sub-themes that make up this theme are discussed below.

4.4.1.1 Subtheme: Connection of digital, technological, and physical worlds.

To confirm the above, 15% of participants (P1, P6 and P19) articulated their understanding of 4IR as the benefits of the technology to business and society.

"The concept of the fourth industrial revolution looks at how businesses and society at large can benefit from the upscale of economic progress. Personally, I believe that the fourth industrial revolution is characterized by being able to connect digitally within the physical world" (P1).

"This is a concept that defies how enterprises use technology within their operations. This revolution also extends outside businesses as it is also used within government departments and people's lives" (P19).

"This is a digital and technological revolution that is impacting every aspect of human existence" (P6).

A recurring concept from the above responses is centred on the convergence of digital, technology and humanity. This is evidenced in the statement attributed to P9 that 4IR suggests the integration of technology and humanity.

"I believe technology is affecting every aspect of life. There is a great integration of the two. Everybody wants things better and faster and simpler. Information and control by a person's fingertips" (P9).

The above thus meant that interconnecting the physical and digital world would encourage smart manufacturing, as the firm will leverage the data available at their fingertips. The finding agrees with Ghobakhloo (2019), who found out that interconnectedness and fusion of physical and digital worlds are at the heart of smart manufacturing. Agreeing with Lasi *et al*.

(2014), it thus meant that the integration of information and digital technologist into every facet of manufacturing will be a strategic priority for contemporary manufacturers.

4.4.1.2 Subtheme: An integrated system, building on the old revolutions

Two participants revealed that 4IR has manifested in the 21st century as an integrated system that is built on old revolutions.

Participant 1 substantiated this by noting that compared with the previous technological revolution, the 4IR is being driven by an integrated system such as cyber-physical systems, the internet of things, cloud computing and big data.

"Contrary to Industry 3.0, where the integration was only possible to a limited extent depending on the interface the systems ran on, meaning the systems only offered limited connectivity between each other and therefore could not reach their full potential. The main drivers behind Industry 4.0 are, among others, Cyber-Physical Systems (CPS), the Internet of Things (IoT), cloud computing and big data analytics. These features have facilitated the uptake of this concept in the 21st century" (P1).

Participant 12 shared a similar sentiment of an integrated system by noting the following.

"Because everything is now connected to a central source. Look at how the Internet is controlling our lives, if it were to shut down, the banks will be in trouble" (P12).

Another evidence of the manifestation of the 4IR concept in the 21st century is the integration of the digital world with that of the physical. As Participant 6 notes, the 21st century is blurring the lines between the physical, digital, and biological spheres thereby influencing how people communicate, consume, produce and or work. This only could be possible due to the integration of a different system together.

"The 21st century is changing the way in which people communicate, consume, produce, and work, blurring the lines between the physical, digital and biological spheres, and giving way to a deeper integration of technology into society. This manifestation is thus influencing all business disciplines, and economies, and even challenging what it means to be human" (P6).

Despite the above indication supporting the manifestation of 4IR in the 21st century, three of the participants had their doubts if truly the 4IR did not entirely manifest in the 21st. In their position, they believed it is the product of previous revolutions. These are consistent with other scholars that 4IR follows the previous three revolutions (Baldas-sari and Roux, 2017; Naude, 2017). Participant 20, for example, thinks such technological advancement has been attributed to the 4IR manifested first within the 1st industrial revolution.

"I think it manifested within the 1st industrial revolution. The 4IR is just enjoying momentum from the other revolutions" (P20).

Participant 4 echoed similar sentiments about 4IR manifesting in the 21st century. In the participant's view, the manifestation of 4IR is stated from the previous revolutions.

"I doubt it has manifested in the 21st century but it is being exposed in this century. The manifestation started a long time ago from the previous revolutions" (P4).

Participant 8 thinks it began during the 3rd industrial revolution.

"I doubt it has manifested in the 4th Industrial Revolution as this is a new era that stems from the 3rd Industrial Revolution" (P8).

Summary

Even though levels of understanding of 4IR within a country, region, and continent usually vary across various sectors and population groups (Mtotywa *et al.* 2022), manufacturing SMEs in Durban have a common view. In their perspective, 4IR is the integration of physical, digital, and technological systems building from earlier revolutions to enhance connection. This definition is in line with Andreoni and Anzolin's (2019) study of 4IR in developing countries.

4.4.2 Theme 2: Improvement of business processes

The response of participants led to the uncovering of this theme named "Improvement of business processes." The responses suggested that 4IR brings change that leads to an improvement in business processes. This is similar to findings by de Koker and du Plessis (2020), in their study of knowledge management firms in South Africa. Nearly all the

participants agree with the above statement, as a common sentiment that 4IR provides opportunities for SMEs to improve efficiency, productivity and improve value chain to the benefit of customers.

Sub-themes that make up this theme are discussed below.

4.4.2.1 Subtheme: Modernisation of production

Quality to meet customers' expectations and the need to increase productivity had an influence on the rise and awareness of 4IR within SMEs. Four of the participants shared this position. Participant 1 notes that the SME's desire to increase productivity as well as the visibility of the business within South Africa and globally had influenced the rise of 4IR.

Participant 12 hinted the need to offer quality to their customers had influenced the rise of 4IR within the firm.

"The need to offer quality to our school clientele" (P12).

"…our SME seeks to increase productivity and be able to put our business on the map both within South Africa and the rest of the world" (P1).

Participant 10 add that the company's desire to speed the processing of their product influenced the rise of 4IR.

"A need to speed up the processing of our chillies" (P10).

Participant 18 also express a similar position on the desire to increase production influencing the rise of 4IR.

"I think it has been a need to increase production (volume of books and stationery)" (P18).

Participant 6 was more particular about the association between productivity and economies. In the participant's own words:

"At the core of this awareness is the objective of driving technological principles and solutions that increase economies of scale within my enterprise" (P6).

4.4.2.2 Subtheme: Improve productivity

While participant P4 notes that digital transformation and technological use will result in job displacement, job evolution and changes to work processes, it will also improve the work process.

"In all honesty, the influence of automation and technology is expected to impact workers across the country. Technological advancements are predicted to impact workers through job displacement, job evolution, changes to work processes and changes to working conditions. On the other hand, there is going to be an improvement in the work process" (P4).

Participant P7 believed digital transformation and technological use are much more important within the manufacturing sector due to their ability to improve work efficiency.

"Digital transformation and technological use are important within the manufacturing sector because of their ability to transform inputs into outputs at a precise level" (P7).

Seven participants believed that the digital transformation that makes sense to the manufacturing sector is aiding efficiency and productivity. Such efficiency and productivity could be in the form of time, production cost and quality.

"Within our industry, a transformation is one that is able to capitalise on efficiency and productivity. Producing quality wood products at the most affordable price. That is transformation" (P1).

Another efficiency and productivity manifest in the form of offering work to people improving production and processes.

"One that offers people work and at the same time improves production" (P11).

"This is one that improves productivity whilst ensuring employees are able to feed their families" (P4).

"Improvement in business systems" (P3).

"Using these drivers to our advantage can bring companies within the manufacturing improvements in their efficiency, productivity and performance. To do this, companies will have to make changes in their value chain model. The changes might be met with fierce resistance from other players in the value chain who might not see the importance of technology" (P1).

"The industrial revolution in Durban offers diverse opportunities in reference to new markets for the sector. The utilisation of technology within the manufacturing base allows for the exploration of an efficient production chain. This means that Durban can support its Ocean economy well" (P2).

"I think it will bring positive news to the regions, as companies will be able to produce at a large scale. In essence, the manufacturing sector in Durban will be able to increase its economies of scale based on the 4IR" (P18).

"Becoming a world-class African production city" (P14).

Nevertheless, P19 believes that there are more opportunities when compared to the risks of 4IR within the SME. The participant reiterates the opportunity of expediting production and efficiency.

"I think there are many opportunities as compared to risks within the enterprise. Looking at our value chain which is huge in numbers, the technology might expedite production and efficiency" (P19).

Equally, three participants understood the concept of 4IR to mean the utilisation of technology for the benefit of business and humanity.

"I think this is the utilisation of technology within businesses and people's lives (P11)".

"I personal think it is the full utilisation of IT and its related components within the business and social sphere" (P16).

"Use of technology at an advanced stage" (P15).

Such utilisation can also be seen through the lenses of how technology can aid in the production of goods and services.

“I think this is the utilisation of technology in our lives. In the context of business, this looks at how technology can aid in the production of goods and services” (P3).

Another literal understanding of 4IR is centred on modernising the production process in view of increasing productivity and efficiency through automation. These are reflected in the statements below.

“According to my own understanding, the 4IR is the modernisation of speeding up processing systems. Fast-tracking the production process” (P10).

“This is a revolution that looks at how technology can be amped up to improve efficiency and productivity” (P2).

“I think the 4IR is the modernisation and improvement of manufacturing and work processes as a result of automation and technology” (P4).

“My understanding is centred on looking at how technology and different automation systems can work together towards efficiency and productivity” (P5).

Participants 3 and 18 mentioned that digital transformation and technological use increases business productivity.

“I think I have a positive take on digital transformation and technological use. For instance, at our firm, technology has assisted us to increase the number of books and stationery in our wide markets that covers KZN, Gauteng and Limpopo Provinces” (P18).

“I think it is a viable approach as its aim is to improve people's and businesses' life. On our hands, we are able to increase productivity” (P2).

4.4.2.3 Subtheme: New innovations

The new innovative technology in both car manufacturing, housing and chain store affirm the manifestation of 4IR in the 21st century. From the views of threeof the participants, Covid-19 increased visibility and accelerated the shift to technology.

"As they say, necessity is the mother of invention. It is within this current century that the manifestation of the 4IR is in full swing. I think the COVID era exposed this" (P14).

"On our part as car manufacturers, our headquarters in Munich are leading the way in utilising more IT towards the development of new cars and engines. Just look at the new bakkies developed by the German manufacturers that are the 4IR in full swing" (P16).

"You see it all over. Just look at how Amazon has changed. Air BnB has changed the hotel industry. Your clothing brands have also changed. COVID-19 has accelerated the move of these technologies" (P9).

4.4.2.4 Subtheme: Improves business value chain

Participant 17 believed that digital transformation and technological use improves the business value chain, which is critical for the development of the company.

"I am a fan of processes that improve a business's value chain. A coherent value chain is crucial for the development of a company's bottom line. Further, as you might notice, we are surrounded by concepts of the 4IR everywhere" (P17).

Another benefit of digital transformation to the manufacturing sector is that it adds value to business. These are reflected in the statements below.

"This is one that brings value to an organisation without compromising its values and objectives" (P12).

"This is one that brings value and substance to a business" (P13).

Participant P3 explains that digital transformation adds value to the business by way of cost reduction and providing quality. It thus meant that through digital transformation, the cost of manufacturing would reduce while quality improves.

“Business sense is all about meeting your bottom line without jeopardizing any stakeholders. In this context, a digital transformation is one that adds value to a business. Like us in the clothing industry, cutting costs but providing quality is very important” (P3).

Participant 2 also corroborated the above by sharing the following.

“This is one that produces the highest quality goods at the most economic price. Additionally, several amounts of information tell about the production process went about” (P2).

The benefits of cost reduction through digital transformation is further backed by P19 who as an example, note that digital transformation enables the firm to produce and increase the number of their product at a lower cost.

“For us, this transformation is one that produces a considerable number of beds at the lowest possible costs. I think that’s the best example I can give within the context of our enterprise”(P19).

The above narratives, particularly in respect to improving quality and reducing cost may be associated with the pressure to reduce cost of production while maintaining product quality. This assertion is in consonant with Kohn and Harborth (2018*et al.* (2018), who said that companies are experiencing more and more pressure to increase productivity and quality while cutting costs in the digital era.

Thus, one can rightfully conclude that the integration of innovative new technologies in the work process is crucial when transforming businesses to cope with these increasing requirements. Furthermore, the increase in quality may be connected to product efficiency using digital technology. As P5 notes, the efficient rise in automation and technology brings value to the manufacturing sector.

“This efficient rise in automation and technology brings value to the manufacturing sector” (P5).

While participant 16 believe the digital transformation and technology use is disrupts conventional business model, there use is nonetheless essential in the development of sound products and services.

“Although this revolution will disrupt the conventional business model, I think it is important towards the development of sound products and services. In that context, I fully support the use of several digital equipment’s” (P16).

Participant 9 indicated that the perceived usefulness of 4IR technology lies in its value.

“We understand the value of it. We’ve just installed a solar system, which is 1MB. We understand the value of technology” (P9).

The above aligns with Wingo, Ivankova and Moss (2017) who said that the output quality, which is how the quality of digital technology will influence applied tasks, results in its acceptance.

4.4.2.5 Subtheme: Competitive advantage

Participants 3 and 6 think digital transformation and technology use gives the firm a competitive advantage. For instance, access to cloud computing assists the firm to gather information on its target market.

“Personally, as a businesswoman, I think technology is an important feature in our day-to-day lives. Take for instance cloud computing that is offered by Telkom, it has assisted our enterprise to gather as much information in relation to the market in Durban” (P3).

Such information can help the firm to re-evaluate and amend its business strategies to gain a competitive advantage.

“Digital transformation motivates organisations to re-evaluate and amend their processes, technologies, organisational behaviours, and even the skills required to gain a competitive advantage and thrive in an environment of continuous change and uncertainty” (P6).

This is also evident in the statement attributed to participant 17 where it was stated that the large amount of data collected on customers and competitors helps the business to fine-tune their operation.

“Let’s take my business as an example. The utilisation of technology assisted us in gathering large amounts of data regarding our customers and competitors. We managed to use this

data to change our business processes and fine-tune how we conduct business. To us, this makes sense" (P17).

According to Malik (2019), the goal of the application of 4IR in manufacturing is to improve the competitiveness of the industry in the face of a very dynamic global market. This position is also supported by the statement by P1 which suggests that the perceived usefulness of 4IR technology is in the improvement of the firm competitiveness.

"…to improve competitiveness by integrating value-added information and resources" (P1).

4.4.2.6 Subtheme: Upskilling and knowledge development

Findings show that digital transformation and technological use help to promote a culture of learning and accelerate new knowledge. This is essential given that employees' skills development is vital for the effective performance of the business. According to participant P5, individuals are expected to become experts across a wide range of topics and processes due to digital transformation and technological use.

"I believe that job specifications are changing to include a more diverse skillset with these individuals expected to become subject matter experts across a wider range of topics and processes" (P5).

"A digital transformation is one that encourages organisations to have a culture of learning, empowering employees to be self-sufficient. This way they will continue to evolve their skills and proactively manage their career progression" (P8).

4.4.2.7 Subtheme: Reduction of workload

Another benefit of digital transformation and technological use is the reduction of workload. Participant believed that using digital technology would help relieve manually intensive tasks, which could help alleviate employee workload.

"I associate digital transformation and technological use with the introduction of new technologies such as artificial intelligence, automation, biotechnology and robotics. I believe that these technologies are going to be further integrated into their lives in such a way that they are going to be relieved of administrative and manually intensive tasks" (P8).

Drawing from the above, one could conclude that, despite the concerns related to job disruptions that may happen, resulting from the usage of technology, the benefits of the increase in productivity, work efficiency, and reduction in workload have an impact on how technology is perceived.

4.4.2.8 Subtheme: Promote satisfaction

Also, it was revealed that digital transformation improves satisfaction along the supply chain. This may be associated with a reduction in cost and an increase in product quality that benefits both the business in terms of profits and the customers.

"A transformation that makes everyone happy within the supply chain management" (P15).

Summary

From the above narratives, it is evident that 4IR holds numerous benefits such as modernisation of production, improvement of value chain and productivity, upskilling, reduction of workload and satisfaction, competitive advantage and innovation for SMEs in the manufacturing sector. The findings agree with Ghobakhloo and Chang (2019), who that the adoption of digital technologies promises many benefits to SMEs. Findings show that 4IR helps improve the efficiency of production, gives SMEs a competitive advantage, help generate revenue, and promote growth.

The findings are consistent with other researcher who found out that digital technology adoption offers performance improvement for businesses through improved sales, effective customer and supplier relationships and supporting core organisational capabilities (Abebe 2014; Singhry *et al*. 2016; Liao *et al.* 2017).

4.4.3 Theme 3: Growth and transformation

Among other things, 4IR provides more opportunities for industry expansion across industries and sectors through globalisation and cooperative alliances, particularly in the digital economy (Kayembe *et al*. 2019). This has a significant impact on businesses as it extends its exposure outside their national boundaries, and subsequently grows the economy. In this study, the sentiment of participants regarding 4IR supported this notion. The responses of

the participants led to this theme, ‘Growth and transformation’, which explains that 4IR brings industrial growth and transformation.
The sub-themes that make up this theme are discussed in the subsequent sections.

4.4.3.1 Subtheme: Placing business on the map

Participant 1 shared that as a business owner, the approach to digital transformation and technological use is to help place the business on the map. However, he cautioned that digital transformation comes at a hefty cost.

“As a business owner, the approach of digital transformation and technological use is important in placing my business on the map. On the other hand, this transformation, unfortunately, comes at a hefty cost” (P1).

These perceived costs may be connected to P10’s concerns, job losses. It thus meant that while digital transformation and technological use increase business visibility in a global space, it, however, ends up affecting local content in terms of the job.

“For us as up-and-coming entrepreneurs, digital transformation is good but damages the jobs of our brothers” (P10).

4.4.3.2 Subtheme: Growth of economy

Nevertheless, two of the participants agreed that digital transformation and technological use is essential for growth and the economy.

“It is very important for the growth of the economy” (P12).

“Although I’m not a fan of robots, I think it is viable towards economic growth” (P14).

Also, digital transformation helps the manufacturing business to generate revenue. For instance, the use of robotic technology helps car manufacturer to produce cars at low cost, which help them makes profits.

“I will refer to this answer within the car sector. Such a transformation is one that produces the best product at the best production cost. If robots can produce cars at a low cost, then this makes economic sense as the goal of a business is to make a profit” (P16).

Participant 20 notes that digital transformation brings money to the business.

"*This is the one that brings more money into my pockets" (P20).*

In manufacturing sector, and other sectors in general, it is critical to achieve comparative advantage and sustainability of the product. According to the views of participant 18, digital transformation helps to achieve the above.

"I think a digital transformation is one that helps firms grow to become the best of their abilities" (P18).

4.4.3.3 Subtheme: Promote change and transformation

For participant 6, the digital transformation that brings about significant organisational changes are relevant for the manufacturing sector. It thus means that digital technology that drives business transformation is critical and essential in the sector.

"The automation and digitisation of specific functions that brings about significant organisational changes to current business models across all industries and sectors is one that makes more business sense. In line with the provision of beds and mattresses" (P6).

Summary

Respondents agree that 4IR brings growth and transformation. The use of machines, telecommunications, and new advancements in technology brings major changes and transformation in the history of human society. However, respondents are concerned about job losses caused by digital transformation and technological utilisation associated with 4IR.

4.5 Themes and sub-themes for Objective 2: Determining factors that influence the awareness of 4IR among manufacturing SMEs in Durban, KZN.

From section 4.3, it can be observed that themes 4 and 5 apply to objective 2. These themes and their sub-themes are presented below in table 4.3.

Table 4.3: Identification of themes and sub-themes for Objective 2

Theme	Sub-themes
4. 4IR utilisation drivers.	-Covid-19 pandemic. -Social media influence. -Utilisation of new technologies by big cooperations. -Globalisation and market connectivity. -Competitiveness.
5. Risks and opportunities of 4IR.	-Automation, job losses and uncertainty. -Impact on economy.

4.5.1 Theme 3: 4IR utilisation drivers

Globally, and across industries, it has been suggested that 4IR technologies are set to impact businesses significantly which, naturally, will also be true for manufacturing SMEs (Craven, 2017; Kayembe *et al*. 2019). This theme named "4IR utilisation drivers" explains participants' perception of what they believe as the major factors influencing the growth and awareness of 4IR in their SME.

Six sub-themes make up this theme and they are discussed below.

4.5.1.1 Subtheme: Covid-19 pandemic

It is also during the peak of Covid-19 pandemic when the world witnessed the emerging of virtual technologies such as Zoom and Ms Teams that are associated with 4IR. Likewise, Participant 1 notes that the current wave of the pandemic influenced the rise and awareness of the 4IR in their sector. From the participant's view, the way the developed nations used the technology to navigate the challenges brought about by Covid-19 had a major influence.

"A current issue has been that of COVID-19 and how the developed nations are utilising these phenomena" (P1).

The finding is consistent with the review by Agbehadji *et al*. (2021), that show that businesses revised their service delivery models to include 4IR technologies and avoid physical contacts during the Covid-19 pandemic. Particularly, manufacturing sectors utilised robots in manufacturing to reduce human-to-human physical contact. It is therefore evident that, even

though Covid-19 is recent, however, the world witnessed a rise in the utilisation of technologies that are associated with 4IR. It is also worth noting that only 1 participant out of 20 mentioned is as a factor that rises the awareness of 4IR among manufacturing SMEs.

4.5.1.2 Subtheme: Social media influence

Social media was identified as another element that drive the awareness of 4IR in general, and specifically to manufacturing SMEs in Durban, as mentioned by participant 13. Through its diversified role, it has proven to be a distinct and pivotal marketing tool in shaping the success of any product, service and business (Eid *et al*. 2019; Wamba *et al*. 2019).

"Exposure to the Internet. There is a YouTuber known as MKBHD and he talks a lot about the need for businesses to embrace the 4IR" (P13).

4.5.1.3 Subtheme: Utilisation of new technologies by big cooperation

Industries are anticipated to observe new technologies being introduced to create new and innovative ways of addressing existing needs and requirements, thereby, disrupting existing industry value chains (Serumaga-Zake and van der Poll, 2021).

Our findings, through 4 out of 20 participants acknowledged the utilisation of new technologies by big corporation as one of the influences of the rise of 4IR awareness among SMEs in Durban. Big corporates are trend-setters as SMEs often look up to them.

"The emergence of new technologies and the rise of digitisation ignited an unrelenting change in the way that we do work within the enterprise" (P4).

"It is clear that 4IR is impacting the labour market in several ways. Although the work indicates that the elimination of jobs is not the most concerning issue facing workers, the changing skillsets as a result of role evolution, technological advancements and the rise of the economy, are the factors that influenced the rise and awareness of 4IR within my enterprise" (P5).

Participant 15 shared that working with big organisations like Woolworths influenced company awareness.

Working with big organisations like Woolworths has influenced our awareness (P15).

Participant 16 emphasised that the desire to emulate big cooperation globally has had a positive influence on the use of 4IR.

"Honestly, it is the need to emulate the big car manufacturing companies of Europe and the United States of America. Those are our role models in terms of the 4IR" (P16).

Participant 19 also shared similar sentiments as above by highlighting the following.

"Looking at big establishments within our industry, I've noticed how they are continuously developing as a result of incorporating these vast technologies. Take for example how Sheet Street is continuously developing its product line. We would want to emulate such a positive development within the context of our business" (P19).

4.5.1.4 Sub-theme: Globalisation and market connectivity

Apart from the influenced big cooperation has on 4IR rise and awareness within the SME, it also emerged that globalisation has had an impact. For example, the technology innovation and advancement in other more advanced countries have had an impact on the awareness and conscious rise of 4IR within the SMEs in Durban.

These are reflected in the following statements.

"We live in a global world, thus what happens in Dubai from a technological base will reach someone staying in Umlazi. So, globalisation has facilitated this as companies within Durban seek to be able to play on the big stage through the utilisation of technology. In our SME, we are proud to be using artificial intelligence" (P2).

"I think it is exposure to what first-world countries like the United States of America are doing within the utilisation of digitalisation, artificial intelligence and robotics. We always look at what top companies from those areas do and, in most cases, do a replica" (P7).

4.5.1.6 Subtheme: Competitiveness

4IR technologies are anticipated to assist with some of the challenges faced by these manufacturing SMEs to gain a competitive advantage and sustainable business performance (Serumaga-Zake *et al*. 2021). Consistent with this, Durban-based manufacturing SMEs also regard competitiveness as an influence on the rise and awareness of 4IR within the SME.

“The need to compete on the global stage” (P20).

“I think competition played an important factor. Also, the need to improve our business operations at staying relevant to our customers” (P3).

Participant 9 was more explicit that remaining relevant in the business and competitive influenced the rise and awareness. This is vital as one could draw out that failure to innovate and remain competitive may be disastrous to the business.

“Remaining relevant because once your competitors have information that you don’t have, they might put you out of business” (P9).

Thus, and as opinionated by P8, rethinking the business models become highly imperative using 4IR technologies.

“Rethinking our strategies and business models made us consider the impact of the 4th Industrial Revolution on various aspects of our business, particularly the workforce. This influenced the awareness aspect” (P8).

Furthermore, the desire for uniqueness has led to product adoption Botha (2019). This could also explain the rise of 4IR within SMEs. Participant 17 shared that the need to be unique and standout from the crowd has given rise to 4IR.

“The need to be unique and standout from the crowd. As such we discovered that to do so, we need to use the several components embedded within the 4IR” (P17).

Summary

When participants were interrogated about factors influencing the growth and awareness of the 4IR within their manufacturing SMEs in Durban, it was discovered that the Covid-19 pandemic, social media influence, big corporations' utilisation of new technologies, glocalization or market connectivity, and competitiveness were utilisation drivers. These factors were then grouped in the theme, “4IR utilisation drivers”. These are regarded as positive drivers due to their association with opportunities for industry expansion across industries and sectors through globalisation and cooperative alliances, particularly in the

digital economy (Kayembe *et al.* 2019). Notably, Covid-19, a new phenomenon emerged as a factor that brought about both opportunities and threats to industries.

4.5.2 Theme 4: Risks and opportunities of 4IR

Several other changes happening in the environmental, social, economic, technological and geopolitical spheres of our society result in countless risks, challenges and opportunities for human development (Amorim *et al*. 2019). As such, it was vital to know the risks and opportunities of 4IR within Durban-based manufacturing SMEs and the South African economy. The responses of the participants led to the theme, “Risks and opportunities of 4IR”.

Two sub-themes make up this theme and are discussed below.

4.5.2.1 Subtheme: Automation, job losses and uncertainty.

While 4IR increases inequality due to the disruption of the supply in the labour market.

Nevertheless, automation presents an opportunity to increase operation value and economic return through increased productivity, efficiency competitive advantage, creation of new markets and connectivity to the global market. However, 50% of participants highlighted job losses as a major risk that could come with these changes. New technology that is being adopted creating a sense of uncertainty in the manufacturing sector. It is anticipated that as this era progresses, new tools and systems are being required and introduced, resulting from the automation of certain job functions. The equally result to redundancy of some of the current skills.

“Although there is minimal impact currently, I anticipate that as this era progresses, it is going to introduce new tools and systems, resulting in the automation of certain job functions. This is going to lead to the redundancy and transformation of current skills. Unfortunately, many people won’t be able to retain their jobs” (P8).

"As 4IR progresses, it will increase inequality as labour markets are further disrupted. Technologies such as automation and artificial intelligence will substitute many job functions, and the net displacement of workers by machines will exacerbate the gap between return on capital versus return on labour. The opportunity on the other hand is that the value chain will increase its economies of scale and scope" (P6).

"The threats of automation and technology and the growing demand for manufacturing workers are causing great uncertainty" (P5).

"Driven by technology, an organisation's most valuable resource will no longer be its large workforce. Instead, it will be its technology and its most talented individuals, with the most relevant skills being retained. In the long run, this is going to impact manufacturing enterprises in Durban, KwaZulu Natal, where the creation of employment has been providing the country with low-cost labour" (P6).

Participant 10 shared that while investing in modern technologies will improve the effectiveness of the firm production over time, it will nonetheless come with a risk of job losses.

"Investing in new technologies means that our production will be time effective. The disadvantage is that people will be jobless. It means I will be producing for certain individuals who can afford the product. I am passionate about job creation" (P10).

The risk to a job is also highlighted by P16 who anticipated risk is job losses and the irrelevance of workers unions. While there are risks of job loss, there is however an opportunity for the SME to increase production and their market base.

"As stated earlier on, jobs will be lost and COSATU will become irrelevant in the country. Do you think the robots will need a union? Their union will be the IT guy we've hired in our company. The positives are that it will be easier to manufacture cars" (P16).

"In simple terms, the risk is job loss whilst the opportunity is an increase in production and market base" (P20).

Besides, the risks of job losses due to technological innovation, there is also a concern that these technologies are expensive and may not be affordable to SMEs.

"As a small manufacturing company, several opportunities have arisen as the one I stated of collecting large amounts of data. The disadvantage is that some of these technologies come at a hefty price that is not affordable by small businesses" (P17).

While there are perceived opportunities to connect to the global world through technological innovation, yet again, the risk of job loss is mentioned by other two participants.

"The risk is people losing their jobs whilst a stand-out opportunity is that of connecting to the global world" (P11).

"I believe technology creates new markets but also kills jobs within those markets" (P14).

Participant 15 attributes the risks of job losses to those who may fail to understand the new technology.

"Everything has a risk and return. The risk is that most people who don't understand the system will be jobless" (P15).

Automation relies in the collecting a large amount of data. Even through this increase efficiency and productivity through new technologies such as AI, it also comes at a very high cost and may have negative consequences such as system crashing. Participant 18 reiterates this by stating that the ability to synchronise several large amounts of data can help with production.

"Everything has a risk and reward to it. The reward is in the increase of production and the ability to sync several large amounts of data. The risk is that if we become dependent on these systems, they might crash one day, and we will be in trouble. Additionally, running these systems is costly for small enterprises like ours" (P18).

Such fear of the risk of overreliance on technologies in production is also noted by P2 who shared the following:

"The biggest opportunity is efficiency whilst the biggest risk is over-reliance on these mentions that human beings become redundant within the production line" (P2).

Furthermore, P9 amplify this risk by highlighting the following.

"It is highly risky as you become more and more reliant on something that requires more of an integrated system will affect the business anyhow. If one thing fails, the entire system could fail. I think that is hugely risky, I don't think the world understand the risk behind this. For example, our Government gets hacked and shuts down the entire system and the department of home affairs gets shut down. We haven't fully understood these systems. Imagine if there is a global event and the system shuts down. The globe will have a recession. I think that is going to happen anytime soon as this is the nature of progress. When you build something, it might crush. This is will lead to the 5IR, which results in something going horrible wrong in 4IR" (P9).

4.5.2.2 Subtheme: Impact on economy

The end benefit of the increase in production, business systems and competitive drive is the economic development. Thus, similar end results are expected in Durban. More than 25% of our participants expects the new opportunities by 4IR in the manufacturing sector to be a contributor towards economic development, over and above existing ones, and the promotion of entrepreneurship that influences the awareness of 4IR.

*"Development my brother for the economy" (*P13)

"More money in the economy" (P15)

"Growth in the GDP of the province" (P17).

"Durban is a multi-diverse city with several economic activities occurring. The fourth industrial revolution will be able to consolidate these activities into a holistic system" (P3).

“The industrial revolution in Durban offers diverse opportunities in reference to new markets for the sector” (P2).

“In Durban, 4IR will be used as a tool to design a competitive and efficient business operation and strategic position, while business/enterprise owners can apply the concept to be able to study performance, value streams, consisting of value creation, value delivery and value capture, and innovation of their businesses. This in the long run will improve the economy of the city” (P1).

The new market opportunities could consequently result in entrepreneurship development. Participant 8 reiterate this by noting that the 4IR will create an entrepreneurial spirit across Durban and the entire province of KwaZulu-Natal.

Summary

Although modern technologies and technical advancements during the era of 4IR have the potential to enhance human life, they also raise worries about the future. One of the major concerns with emerging technology is that automation and artificial intelligence would eliminate the need for humans in the workforce, causing "technological unemployment." People have previously perceived technology advancement as a danger to their jobs (Zervoudi, 2020).

Likewise, 50% of participants also highlighted job losses as a major risk that could come with these changes, making it the most concerning factor to employees. A dominant 4IR opportunity offered to SMEs, as highlighted by more than 20% of our participants is competitive advantage. The SMEs confirm that having information at one's fingertips gives a strong competitive edge to the firm. The above-mentioned risks and opportunities mainly serve as drivers of awareness in general and of 4IR specifically in Durban-based Manufacturing SMEs. From the contribution on our participants, one could subsume that the risks of 4IR are centred on job losses and the cost of the technologies whilst the opportunities are on production efficiency.

4.6 Themes and subthemes for Objective 3: The level of technology acceptance among manufacturing SMEs.

From the numbering of the themes as indicated in section 4.3, themes 6 to 8 apply to objective 3.

Given the perceived benefits of 4IR adoption by manufacturers to the economy and development of Durban, it was vital to know the level of technological use by the firms. To ascertain this, participants evaluated their level of technological acceptance and technological use towards the achievement of business goals.

Table 4.4 shows the three themes and their individual sub-themes that pertain to research Objective 3.

Table 4.4: Themes and sub-themes for Objective 3

Theme	Sub-themes
6. Progressive work environment.	-Enhance collaboration. -Early detection of mistakes. -Timesaving. -Enhances communication.
7. Getting familiar with new technology.	-Getting used to new technology. -Challenging. -Easy to use.
8. Alignment of purpose to digital age.	-Immediate incorporation of new technology. - The gradual incorporation and adaption of new technology. -Re-skilling and up-skilling. -Collaboration on skills and knowledge. -Research and development. -Embracing technology.

4.6.1 Theme 6: Progressive Work Environment

In organisations, every individual has a perception of how useful and effortless it is to adopt technological innovations (Baaziz, 2021). It thus means that the perceived usefulness of technologies is highly subjective and depends on the individual user. Given this, it was critical to explore the participants' views on the perceived usefulness of technologies. From the responses of participants, the following subthemes were uncovered.

4.6.1.1 Subtheme: Enhance collaboration

Collaboration came up as one of the features of 4IR. Participant 1 notes that 4IR enhances collaborations.

"One of the main reasons behind the creation of networks is to enhance collaboration and exploit the core competencies of business processes" (P1).

The above agrees with the semiconductor manufacturing industry in USA who have collaborated in the formation of smart manufacturing community and to focus on challenges that arises along with the adoption of technology (Weber, 2020).

4.6.1.2 Subtheme: Early detection of mistakes

Kohn *et al.* (2018), shared that the tiniest mistake in manufacturing can cost several hundred million dollars. Given the economic consequence of mistakes in manufacturing, Kohn *et al*. (2018), note that companies are reaching out to find solutions to reduce error rates, increase productivity, cut costs, and ultimately gain a competitive advantage over global competitors. This also explains why participant four consider 4IR technology useful in the early detection of mistakes.

"Within my factory, the usage of big data, cloud computing, integrated interfaces etc. is something we cannot touch and see. This affects human interaction at most. In my factory we have deliberately chosen to keep checkpoints with human interaction in order to see what is going on with the product, so a mistake can be spotted early on in the production process, this is something a machine cannot do. We will get there one day" (P4).

4.6.1.3 Subtheme: Timesaving

Participants believe that 4IR technology aids in timesaving. For instance, Participant 10 believes that 4IR technology saves time and is thus useful in the manufacturing sector.

"It is very much useful, and it is time-saving" (P10).

4.6.1.4 Subtheme: Enhances communication

Participant 4 indicates that 4IR enhances communication. This may be connected with the integration of the digital system. Thus, it is reasonable to agree with P4 that 4IR has accelerated the shift to telecommuting, which makes it useful. Other participants share this sentiment. In the participant 14's words,

"Within the manufacturing sector, technology has allowed for more open lines of communication between employees and employers, with remote access no longer a major challenge. SMEs are no longer limited by ICT infrastructure to adhere to a typical office environment, with the rise of telecommuting, replacing face-to-face interaction. The changes are thus incorporated gradually" (P4).

Summary

One can infer that Durban-based manufacturing SMEs identify the adoption and usage of technology with value and benefit since participants relate it to enhance collaboration, early mistake detection, timesaving, the enhancement of collaboration and communication. This is also associated with one of the improvements of life in general, a feature of 4IR.

4.6.2 Theme 7: Getting familiar with new technology

The theory of Technology Acceptance Mode (TAM) first promoted by Davis (1989), suggests how readily people will accept modern technology. Deslonde and Becerra (2018), explain that TAM predicts the level of technology acceptance and usage, categorized into Perceived ease of use and perceived usefulness. In the previous subtheme, the researcher explored the perceived acceptance of new technology. This subtheme uncovers the perceived ease of use of technology by the respondents. According to Deslonde *et al*. (2018), perceived ease of use (PEU) is the degree to which a user believes that using a particular technology would require minimal effort. Thus, the participants were asked the following question "How would you perceive the ease of use of modern technology in your firm by employees?" From the responses, it was uncovered that while some of the participants note that the employees are

getting used to it, many, however, indicate that their employees are much more familiar with the new technology.

4.6.2.1 Subtheme: Getting used to new technology

Three of the participants shared that their employees are still getting used to the new technology.

"Employees are still getting used to the technological developments happening within the site" (P1).

"Some employees are still catching up to the use of the different technologies within the enterprise" (P19).

4.6.2.2 Subtheme: Challenging

Participant 4 revealed that the organisation is struggling to foster collaboration and innovation among staff.

"Our employees are required to be more autonomous, while the enterprise struggles to foster collaboration and innovation amongst staff due to the disruption of the traditional team. This has been the main challenge" (P4).

4.6.2.3 Subtheme: Easy to use

Four of the participants note that the new technology is easy to use.

"They are easy to use" (P10).

"They are easy to use" (P11).

"The technology we have is very easy to use" (P15).

"It is easy to use" (P20).

The above view may be associated with the gradual introduction and training of employees on new technology. As P17 said, there is nothing difficult using the 4IR technology, as employees are up to date.

“There is nothing difficult with using the technology we have. All of my employees are up to date with the machinery” (P17).

Besides, and as extracted from participant 18 words, the current technology is very adaptable to the employees. This also reinforced the training of employees on the modern technology.

“The current technology is very adaptable to employees” (P18).

Participant 3 believes that employees do not have a problem with the 4IR technology as it can use at hand.

“Most employees can use the technology at hand. They don’t have a problem” (P3).

Furthermore, it was gathered from the data transcribed that most of the employees are familiar with the 4IR technology due to continuous training. This is also connected to a form of training received by these employees on modern technology. The assertion is supported by the views of P14 who said that the organisation trains their employees to understand the technology and use it.

“We train our employees to understand the technology we use” (P14).

Hence, one can rightly say that employees who are trained have a strong grasp and understanding of 4IR technology. This is evidenced in the statements below where it is stated that employees understand the depth of technology due to being trained in the field.

“We are only two but we do understand the depth of technology” (P13).

The employees understand the process well. We’ve actually trained some in this field (P7).

Participant 9 was more explicit by revealing that the organisation has online courses for employees on the 4IR technology.

“We have online courses for the employees. We have all the correct systems. So, we have easy use of the systems” (P9).

Apart from organisation training their employees on 4IR, it was worth noting here that some of the employees come with basic skills from their schooling.

“We have an educated workforce. Most of our employees learnt the basics of these systems at school, so basically, we are covered” (P8).

Summary

Findings indicate that even though some SMEs are still finding their feet regarding the “ease to use” of technology, with others highlighting the integration of technology to the exiting business culture as challenging, training is viewed as the enabler in overcoming this challenge. This attitude towards the adoption of technology by SMEs corresponds with counterparts from countries such as Malaysia and Iran (Ghobakhlo and Chang, 2019). Another factor that is associated with the use of technology is the desire for future growth, as eluded by participant 17. The perceived usefulness of technologies is derived from enhanced collaboration and communication, improved firm’s competitiveness, early detection of mistakes, and value added. The perceived ease of use on the other hand, of technologies and strategies linked with the digital age serves a barometer of acceptance.

4.6.3 Theme 8: Alignment of purpose to digital age

As observed by Botha (2019), the attention on innovation is shifting to new models in the context of 4IR, which describes the manufacturing environment. It was thus crucial to know how the firm’s purpose, vision and strategy needed to evolve for the digital age.

From the collected data, different strategies were noted by some of the participants among which include immediate, gradual and continuous incorporation of new technologies, continuous adoption to new technologies.

4.6.3.1 Subtheme: Immediate incorporation of new technology

Participants 14 and 18 revealed that changes are incorporated as concurrently as they are introduced in the market. It thus meant that as new digital technology is launched in the market, the firm acquires this for business operations.

“Changes are incorporated along with the introduction of a new machines into the market” (P14).

Participant 18 revealed interesting information on the company having a marketing manager who is on the lookout for new equipment.

"Although we are a small enterprise, our employees are in tune with the new technologies offered by the 4IR. Our Marketing manager doubles up as our Researcher and is always on the look for new equipment" (P18).

However, Participant 1 notes that the strategy is to first analyse the benefits of the 4IR to the company.

"Firstly, we had to analyse the benefits that we are going to gain as a company and once we understand the benefits then it is good to implement a vision that complements this. Our strategy has shifted because of this but our vision is still clear on providing quality, durable products to our customers" (P1).

4.6.3.2 Subtheme: The gradual incorporation and adaption of new technology

Responding to the question asked on how digital changes are incorporated by the firm, some of the participants indicated that changes are incorporated with new technology launch in the market while others indicated the introduction are done gradually to allow employees to catch up with the technology.

Six participants indicated that the firms' strategy would be to continue to adapt to new technologies.

Participant 10 noted the flexibility in approaching 4IR technology.

"My approach is very flexible. I'm continuously adapting to new technologies" (P10).

Participant 12 argued that strategies must evolve day since the world is changing rapidly.

"The strategy must evolve every day, the world is changing very fast" (P12).

The above is important as failure to change may make the firm irrelevant.

"Businesses need to change or else they will remain irrelevant" (P13).

Participant 19 echoed similar sentiments as above by using the phrase 'adapt or die' which means adapt to changing the world or become irrelevant in the current scheme of things.

I think every enterprise within the manufacturing sector needs to evolve as a result of the digital age. As the saying says, 'Adapt or Die' (P19).

Adding further support, participant 2 believe that business system should evolve every time due to the uncertainty in the business environment. This, the participant think is vital in the firm positioning to industry 4.0.

I think a company's business system should evolve every time due to an uncertain operating environment. I believe that firms that experience changing their operation an important thing to keep in mind as it might influence their perspective and positioning to industry 4.0 (P2).

Furthermore, as firms diversify into new areas of interest and mission, it is also vital that the strategy evolves along with the vision. This is according to the view of participant 9 who supported this view with his firm's short-term vision to achieve a global status.

It certainly needs to. We have our aspirations for 2025. As a global company, we continuously move to new areas, so our strategy needs to evolve every time (P9).

However, for some other participants, the incorporation of new technology was not immediate due to the opposition from the employees. Participant 2 noted that while some of the employees were first reluctant to use the new technology, they, however, got used to it with proper training. This meant that training employees on new technology is vital before its introduction.

"At first, employees were reluctant on utilising the diverse forms of technology. With time and through intense training we've managed to marry the two well. So these changes were incorporated into the enterprise at a gradual rate" (P2).

Similarly, as above, P3 notes that changes are incorporated gradually to enable employees to learn how to utilise the technology.

"Changes are incorporated gradually so that the employees can learn how to utilise technology" (P3).

The above gradual introduction is essential, as technologies cannot operate alone without the human interface. This assertion can be further supported by the statement from P6 who said that the organisation seeks to re-assess the processes to enable collaboration between humans and machines.

“Our organisation seeks to re-assess the processes, technologies, organisational behaviours, and skills to enable collaboration between humans and machines in such a way that it provides a competitive advantage within the manufacturing sector” (P6).

Another reason for the gradual incorporation of new technology to the firm was attributed to fear held by some of job losses due to technology introduction

“We try to introduce the technology gradually as most employees are afraid that their jobs will be lost” (P5).

In summary, one can conclude that some of the firms have immediate incorporation of technology many others opted for a gradual introduction of new technology.

The reason for the gradual introduction was connected to employees' reluctance, desire to get employees accustomed to the new technology and fears of job losses from the new technology introduction.

4.6.3.3 Subtheme: Re-skilling and up-skilling

Although the 4IR promises several benefits because of its innovations and technological process, manufacturing SMEs also anticipate challenges such as inflation rates owing to the impact of digitisation of retail sales, and price instability, which all lead to demands for improved quality of goods and services (Borg, 2016; Prisecaru, 2017). These challenges reduce SME's readiness to adapt (Serumaga-Zake and van der Poll, 2021). To counter this, there is a need for new strategic innovation to guide manufacturing SMEs in developing economies with scarce resources into opportunities offered by 4IR technologies (Prisecaru, 2017). Thus, it was important to know how the manufacturing profession aims to accelerate its adoption of the new technology.

Education is among the most important aspects to consider for 4IR adoption, and education systems to be reoriented from industrial skills to service needs (Prisecaru, 2017). This was confirmed by most participants noted that that the process of accelerating technology adoption can be achieved through education.

Five of the participants were of the view that the organisation needs to change the skills of their employees as a strategy to align themselves with the 4IR.

"This change to how work is conducted is contributing to the evolution of employee skillsets and the increasing need for flexibility amongst workers. This all is centred on our operating strategies" (P4).

"We also seek to diversify our learning and development offering to encompass the development of both hard and soft skills. It is not enough to focus initiatives on one area, and substantial investment must be made to combat the prospect of a skills shortage" (P5).

"Through education" (P10).

"Yes. Learning doesn't stop" (P12).

"Through education. The 4IR undoubtedly adds value like a baker who creates a website to sell their cakes" (P9).

Such a form of learning can result from observing other more advanced countries and become open-minded.

"By learning from first-world countries like the USA" (P13).

"By being open-minded because these systems don't want a rigid mindset" (P8).

This, since universities are the epicentre of knowledge development, scientific research, and innovation.

"*By listening to what universities are advocating for"* (P16).

According to participant B, technology can be accelerated if young people are given opportunities according to the views of participant 19. This due to young people being more technologically savvy and learning quicker.

"By giving young people opportunities to become part of these enterprises" (P19).

4.6.3.4 Subtheme: Collaboration on skills and knowledge

The emergence of new technology and business models has made the business environment even more turbulent due to competition. Given this concern, it is vital to know if the manufacturing profession works effectively with technologists and business decision-makers

to provide the needed leadership. Building these corporate relationships throughout sectors and utilising cross-sector alliances with academic institutions will be crucial. It is crucial to foster a culture of continuous learning, adopt new ideas, and promote the growth of new technical and soft skills. Change is here to stay, so we need to re-evaluate (Pedron, 2018).

All the participants confirm that the manufacturing profession can work effectively with technologies to provide the needed leadership towards the adoption and optimim utilization of 4IR-relatred technologies. For this to work, there must be a strategic commitment between stakeholders such as business leaders, customers and government that participate in the process. Furthermore, development should be the core of decision-making for a successful adoption of 4IR-related technologies.

Businesses, governments, and academic institutions will need to act proactively to reskill, upskill, and improve employee capabilities to accelerate and technology adoption to remain competitive in the market (Pedron, 2018). Another way to speed up the adoption of 4IR from the South African perspective is to collaborate with other manufacturing companies from other countries.

"By collaborating with other manufacturing companies from other countries" (P14).

The benefits of collaboration are centred on the fact that less developed industries may acquire the required expertise from more advances. This will help in the transfer of essential skills.

"Learning from other countries that have set the pace in the adoption of new technologies. One such country is the United States of America, as most of their companies are now utilising the 4IR" (P20).

4.6.3.5 Subtheme: Research and development

Three participants indicated that the adoption of 4IR can be accelerated through research and development.

"Research and Development or Learning and Development" (P11).

"Through research and development" (P6).

“Continuous research and development within the manufacturing profession” (P18).

The above may be connected to the low investment in research and development of advanced technologies in Sub-Saharan Africa. Several studies have noted investments by governments in high-speed internet technology, for example, infrastructure.

Two of the participants accentuate the need for learning and development and re-evaluation of the process.

“Manufacturing professionals must also engage in relevant learning and development (L&D) initiatives in order to ensure continual upskilling, so that they are not left behind” (P4).

“The concept of learning and development must be re-evaluated within the majority of manufacturing organisations” (P5).

4.6.3.6 Subtheme: Embracing technology

There is no doubt that some sectors of society have resistance to technological use. Thus, it was suggested by P17 that industries must embrace technology fully to accelerate its adoption.

“Not being afraid to use several technologies. Most adults have technophobia and as such it affects business” (P17).

One way of addressing the perceived technophobia as highlighted by P2 is for organisations to invest in teaching employees about the importance of technology in the manufacturing sector.

“By investing in teaching employees about the importance of technology within the manufacturing sector” (P2).

“I think we as business owners need to train our staff on the adoption of new technology” (P7).

Summary

From the responses, participants emphasised the importance of relevant skills in adopting 4IR-related technologies to align the organisation's objectives and strategies to the digital age in instant and gradual basis. More than 70% of the participants are confident that there are formal training institutions that equip employees with relevant skills, and some of these skills are already being utilised. Another approach that organisations can implement to adapt their current strategy for the digital age is the collaboration of talents, expertise, technology adoption, research and development.

4.7 Themes and subthemes for Objective 4: The perception of the fourth industrial revolution among manufacturing SMEs

This section addresses research objective was to identify the general perception of the 4IR among manufacturing SMEs.

In section 4.3, it is indicated that objective 4 is catered for by theme 9. The subthemes that make up theme 9 are represented in table 4.5.

Table 4.5**: Identification of themes and sub-themes** and linking them to the objective 4

Theme	Sub-themes
9. Expectations from 4IR.	-Loss of employment. -Economic benefit. -Improvement of productivity.

4.7.1 Theme 9: Expectations from 4IR

4IR is expected to technologically disrupt several aspects of our society in a developing country like South Africa due to its ability to create new business opportunities. It is also expected to help with some of the issues, and improve competitiveness and long-term company performance, especially in the manufacturing sector for SMEs. (Serumaga-Zake and van der Poll, 2021). It was therefore essential to find out what the participants expect from 4IR, to gauge the expected effect of 4IR on the manufacturing profession over the next

5-10 years in South Africa and weigh the availability of skills sets. From the data, loss of employment, increase in business opportunity, improvement of productivity, and economic benefit were dominant effects.

The sub-themes that make up this theme are discussed in the ensuing sections.

4.7.1.1 Subtheme: Loss of employment

Loss of employment due to a machines taking over the jobs is a risk associated with the use of using 4IR technologies (Serumaga-Zake and van der Poll, 2021). Consistent with this view, participants said there will be job losses from the use of 4IR technology.

"The manufacturing profession will be affected heavily, especially on the job site. I foresee jobs being lost to Robots. This is happening already in America. Check what Elon Mask in doing with Space X" (P1).

Such loss of jobs, participant 11 believes will result in chaos in the country. This has implications as it could affect the social stability of South Africa.

"There will be chaos in the country as trade unions will be at loggerheads with the manufacturing sector. But it will provide some positive gains for the country" (P11).

4.7.1.2 Subtheme: Economic benefit

The growth of the 4IR technologies is associated with improvements and efficiencies to drive economic growth and social upliftment (Serumaga-Zake and van der Poll, 2021). Consistent with this view, three participants believe that, by using 4IR technologies in South Africa can once again become an economic powerhouse in Africa, should it seize opportunities presented by 4IR.

"South Africa will go back to be an economic powerhouse in Africa" (P17).

Participant 2, however, warn that this will come at a great cost with clashes between the trade union and the government because one of the consequences of 4IR use is that it may lead

to job losses. Thus, the perceived clashes between the government and the trade union may be connected to an employee losing jobs to 4IR technologies.

"It will affect the industry immensely. There will be an economic shift, but I also foresee constant clashes between the Government and COSATU" (P2).

Due to this, participant 13 believes their business will have more business opportunities.

"Enterprises like ours will have more business opportunities" (P13)

The above business opportunities may also be attributed to the fact that 4IR reduces labour costs, diminishes the cost of trade and improved economic growth (Schwab, 2016).

4.7.1.3 Subtheme: Improvement of productivity

Technological innovation may lead to a long-term increase in efficiency and productivity (Serumaga-Zake and van der Poll, 2021). Participant 14 who noted that the manufacturing sector will improve production due to 4IR technological use supports this.

"The sector will improve production immensely" (P14).

Participant 4 explains that the 4IR will force organisations in South Africa to be agile in their approach to production.

"It will have penetrated most industries. The 4IR will force organisations in South Africa to be agile in their approach, with an increasing emphasis on instant customer and product solutions" (P4).

Which could help South Africa become a powerhouse in manufacturing due to the use of 4IR.

"In the next 10 years, South Africa will be a powerhouse in the manufacturing sector as a result of 4IR" (P6).

New technologies can assist to process information faster, which in turn drives economic growth, empower individuals, fuel entrepreneurship, and improve the health system (Serumaga-Zake and van der Poll, 2021). In line with this view, P15 believes that the manufacturing profession will benefit immensely because of the 4IR.

“The manufacturing profession will benefit immensely as a result of the 4IR” (P15).

Summary

One can conclude form the above findings that job losses are expected to negatively affect manufacturing SMEs over the next 5-10 years. Job losses also appear as factors that influence the awareness of 4IR among manufacturing SMEs in Durban. Despite this concern, the utilisation of 4IR is also expected to increase business opportunities and subsequently grow the economy. This may be connected to the fact that the use of 4IR technologies opens opportunities for a new market (Min Xu *et al*. 2018).

4.8 Conclusion

In summary, this chapter provides a comprehensive assessment of SME representatives' viewpoints on 4IR in the manufacturing industry. The analysis gave an insight into the understanding of the extent and benefits of 4IR application and adoption within the SME sector in Durban, South Africa. To establish this, interviews with manufacturing SMEs in Durban were carefully drafted to ascertain the extent of 4IR knowledge, factors that affect it, the degree of technological acceptance and how owners and managers generally view 4IR.

The comprehension of the 4IR concept, how it has manifested in the 21sr century, the understanding of digital transformation, the approach towards it and technological usage were cornerstones upon which the level of awareness of 4IR was assessed. According to this evaluation, manufacturing SMEs in Durban have a solid understanding of 4IR.It is also a revolution that is associated with growth and transformation, even though job losses also emerged as one of its features. In the next 5 to 10 years, the general perception from the participants is that, while 4IR continue to unearth numerous opportunities and benefits to SMEs, job losses and costs of adopting new 4IR-related technologies are expected to continue being the associated risk.

Utilisation drivers such as Covid-19 pandemic, social media influence, the usage of new technologies by big, globalisation or market connectivity, and competitiveness were determined as factors that influence the awareness of 4IR among manufacturing SMEs in Durban, KZN. Although these new technologies and technical advancements during the era of 4IR presents opportunities enhance human life, they also raise employment-associated

risks. It is impossible to mention 4IR without mentioning technology. This study therefore needed to determine the degree of technological acceptance to accurately assess the impact of 4IR among manufacturing SMEs in Durban. Collaboration and communication are enhanced by technology, which also helps with mistake identification earlier and time management. As participants linked the above with a progressive working environment, this indicates a positive attitude and firm acceptance of technology by Durban-based manufacturing SMEs. This is further reflected in the fact that, despite some of these SMEs are still getting accustomed to new technologies, they emphasise the need of training for the industry and sector. Notably, participants also highlighted the importance of embracing 4IR-related technology while having the necessary skills to fit the organisation's goals and plans to the digital age. The next section provides the conclusion and offers recommendations on how the manufacturing sector can leverage and utilise the 4IR innovation within SMEs.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction and Overview

This chapter provides a summarised overview of the study. Furthermore, the researcher suggests implications of the study, recommendations for manufacturing sector, and arears for further study. The overall aim to assess the impact of the 4IR on manufacturing SMEs by evaluating factors that influence their understanding, awareness, and perceptions.

5.2 Research problem and objectives

Due to a series of challenges such as the lack of managerial skills, inadequate funding, and technological limitations, the proportion of SMEs that fail within the first five years of their establishment poses a threat to the economy (Milošević, Mihajlović and Stojanović, 2019). This study contextualised various features within the component of 4IR-related technologies by assessing the impact of 4IR on manufacturing SMEs. To achieve this, the following objectives were developed.

- To ascertain level of awareness of 4IR among manufacturing SMEs in Durban, KZN.
- To determine factors that influence the awareness of 4IR among manufacturing SMEs in Durban, KZN.
- To ascertain the level of technology acceptance among manufacturing SMEs in Durban KZN.
- To identify the general perception on 4IR among manufacturing SMEs in Durban, KZN.

5.3 Implications of the study

Numerous studies on the various aspects influencing the failure or success of the SMEs in general have been undertaken. However, only a handful of studies concentrate on

technology, particularly regarding 4IR and manufacturing SMEs. This research therefore fills

the void by assessing the impact of 4IR and its on manufacturing SMEs. The results revealed the following.

4IR, which blends physical, digital, and technological aspects in daily life and business, is understood and known by Durban-based manufacturing SMEs. Thus, it was summarised by collected findings as an enhanced and connected system that develops, transforms businesses, and improves processes. It was also revealed that, through the utilisation of modern technology, it can aid for speeding up processing systems by improving efficiency, productivity and quality of life through innovative technologies. Mixed views regarding the manifestation of 4IR in the 21st century are also drawn for participants. This emanates from the overlapping of features from revolution to the other. However, there is a majority view on the benefit of digital transformation and technological use, when compared with concerns such as job losses. Benefits are associated with improving the quality of life and business performance. These benefits include improvement of value chain, productivity, efficiency, upskilling and revenue generation

Findings also highlight Covid-19 pandemic, social media influence, the utilisation of new technologies by big businesses, competitiveness, globalisation and market connectivity, risks and opportunities are determining factors that influence the awareness of 4IR among manufacturing SMEs in Durban, KZN. Notably, during the spike Covid-19, modern technologies such as AI and virtual communication were used to navigate challenges of lockdown and social distancing associated with this global pandemic. Most participants further viewed these technologies as source of opportunities for businesses that are created by 4IR. However, it is further anticipated that changes in labour market will widen the gap between return on capital and return on labour. This will contribute to predicted job losses and an unstable business environment.

The manufacturing industry has so far uncovered more advantages from 4IR than disadvantages. It views it as a tool for developing economically sustainable and competitive firms, as well as for enhancing processes, boosting productivity, and opening up new business opportunities. This does not come without drawbacks that includes business unpredictability and a lack of skilled workers. There is a favourable assessment of the ease to use and perceived usefulness of new technologies. This demonstrates the degree of readiness for modern 4IR-related technologies. Their utilisation has been deemed useful in

enhancing collaboration, value, and communication, improving and in early detection of mistakes. Most firms train employees on these technologies, making it easy to use. Even though most businesses view modern technologies as progressive, they opt to introduce them gradually through training, research and development.

The reluctance of employees, the necessity to acclimatise people to the new technology, and concerns about job losses due the introduction of modern technologies are other factors contributing to the gradual adoption of digital technologies. The gradual introduction of modern technologies will give room for employee training and understanding of the system. It will also help to improve the integration of the digital and human elements for the maximum application of such systems for the benefit of the firm.

A dominating view on perceptions of 4IR is concerns associated with job losses and costs of adopting modern 4IR- related technologies. This also results from the shortage of skills. It is expected to negatively affect the adoption and utilisation of 4IR-related technologies. However, the gradual introduction of 4IR by an organisation within the sector, as advocated by most participants is identified as a vehicle of giving employees an opportunity to enhance the understand and familiarity of such technologies. This is also based on perceived usefulness and ease to use of the population. While concerns were uncovered, numerous opportunities and benefits to SMEs in terms of production efficiency and economic growth are also identified as factors that inform the effect and perception of 4IR among manufacturing SMEs.

5.4 Limitations of the Study

This research study was conducted in the eThekwini District municipality, focusing only on managers and owners of manufacturing SMEs. Limitation were also evident on the basis that there are manufacturing SMEs operating in Durban, but their sector did not have representation from which data was collected. Moreover, the researcher was not able to acquire enough information when comparing different small businesses from different regions of KwaZulu Natal, therefore was not able to generalise the findings beyond the scope of this study. Due to the Covid-19 pandemic, some interview appointments had to be rescheduled or cancelled.

5.5 Recommendation for Manufacturing SMEs.

New technologies have a substantial influence in all aspects of business, including labour, markets, consumers, and products and services (Baur *et al*. 2015; Lakuma *et al*. 2019). As a result, the literature reviewed on this study has since demonstrated in Durban-based manufacturing SMES, 4IR is perceived to have a significant impact on production and trading as it has changed how customers, government, and the general public live, work and trade. Findings indicate that manufacturing SMEs in Durban have a solid understanding of 4IR, and its associated opportunities and threats upon which the impact of 4IR on Durban-based manufacturing SMEs is underpinned. Considering these findings and to optimise the benefit during this era, this study makes the following investment recommendations.

- **Skills development:** Manufacturing SMEs should invest in education and training to successfully adopt and utilise 4IR in general, and related technologies. In addition to the findings from interviews the same sentiment is echoed by other sectors and nations. For instance, in the 4IR era, industries such as civil technology have emphasised the value of encouraging and nurturing learners' talents as early as possible to aid them for the development of employability skills necessary to successfully transition from the classroom to the workplace and ultimately succeed in this field. (Mtshali, Ramalinga, 2020).

  In countries such as Malaysia, this is achieved through a deliberate collaboration between government, industries and institutions of higher learning for skills development, re-skilling and upskilling (Markowitz, 2019; Sohimi, Affandi, Rasul, Yasin, Nordin, and Adam, 2019). To fast-track the rate of adoption by customers and business development, it is recommended that manufacturing SMEs further extend education and training to customers about new and modified features of products and services. Harnessing 4IR-related skills may subsequently curb the level of uncertainty that is currently associated with 4IR and job losses.

  By 2030, the African continent is expected to have one of the largest workforces when compared with the rest of the world, with a share of workers with at least a secondary education around 52% (Ndung'u and Signé, 2020). Other techniques that manufacturing SMEs can employ to adapt their current strategies for the 4IR era, as s

identified by findings of this study include collaboration of talents and experience, research and development, and technology adoption.

- **Policy review and development:** 4IR continues to change patterns of working and living in unprecedented ways and speed, through the introduction of new or modified ways of doing business living, and trading (Burritt and Christ, 2017). To seize these growth opportunities while minimising or eliminating negative consequences, regulations, and policies are required to advance the positive and inclusive effects of these technologies (World Economic Forum, 2018). It is therefore recommended that manufacturing SMEs review existing policies, and develop new ones to integrate their strategies and operations with 4IR, its' emerging markets and new economies.

These policies should be enabling, accommodative, responsive and interactive to address concerns that relate to funding, regulatory, infrastructure, and skills. This has already been adopted by developed countries such as Malaysia, where overarching national policies promote coherence towards changing their socio-economic development. This is done through the ethical application of 4IR technologies and outlining key focus areas that have an impact on business, government, and the general public(Economic Planning Unit, Prime Minister's Department, 2021). These policies are useful in determining how to best support and promote research and development (Chalmers, Mannetta, and Sensini, 2020). Even though government is responsible for policy, SMEs innovate their business models to accommodate technological disruption.

Innovation, Research and Development: Innovation, research, and development to be the basis for encouraging company growth and sustainability. Additionally, through its findings, it pointed to innovation, research, and development as tools for the reformation of business processes and bringing their goals into the digital era. Globally, Innovation is regarded as a significant promoter of economic development and has aided for the evolution of economic structures (Jia, Tang and Kan, 2020). For this reason, it is recommended that manufacturing SMEs invest in innovation, research and development to proactively provide emerging markets and predict

investment opportunities introduced by 4IR. In developed countries such as Italy, a study discovered that the impact on investing in innovation, research and development by non-high-tech SMEs can enhance performance and benefits up to an optimal level (Chalmers, Mannetta and Sensini, 2020).

Moreover, it contributes to the body of knowledge on the connections between performance, internationalisation, and research and development. It also assists SME managers and owners in directing research and development investments towards the best outcomes (Chalmers *et al*. 2020). Thus, it is helpful for policymakers to allocate aids and investments and for research and development activities towards attaining optimal values.

- **Smart Infrastructure:** According to several definitions, 4IR is centred n globalisation, interconnectedness, and systems with contemporary technologies that integrate real and virtual worlds, fusing the physical and digital worlds. These technologies and systems are very reliant on smart infrastructure, a cyber-physical system that enables the integral management of all its components, using various technology tools that assist in data collection and analysis to achieve efficiency, sustainability, productivity (Steyn and Broekman, 2020). Even though South Africa is still in the early stages of implementing these new systems, they are already enhancing sectors like agriculture and supporting emergency services (Govender, 2019). Based on the above-mentioned benefits, it is strongly advised that manufacturing SMEs invest in these smart systems that uses data to monitor, measure, analyse, and communicate with consumers to improve efficiency and optimum use of resources. The global threat to the collection and storage of big data, which is a necessity for smart infrastructure, is cyber-crime. In the context of South Africa, load shedding that results to unreliable power supply and disrupts network connectivity, since, at the core, 4IR is highly dependent on energy (Tshilidzi, 2020). This therefore exacerbates threats to the sustainability of manufacturing SMEs, particularly in the 4IR era.

5.6 Recommendation for further studies.

Globally, SMEs remain a significant driver of economic expansion and development. By creating jobs, generating income and wealth, they play a significant part in combating socio-economic issues like inequality, unemployment, and poverty, especially for people who are economically excluded. To achieve the above, future research could be done to assess the impact of 4IR across SMEs of various industries. Findings from this study highlighted Covid-19 as one 4IR adoption drivers future studies can also assess the impact of Covid-19 on manufacturing SMEs' use of 4IR in Durban.

5.7 Conclusion

This final chapter has integrated findings on how 4IR impacts Durban-based manufacturing SMEs with literature and objectives of this study. As revealed by several studies that SMEs fail within the first five years of their existence due to several challenges such as poor managerial skills, inadequate funding, and technology restrictions, among others, this has a crippling effect on economies globally. To counter these challenges and in pursuit of SMEs sustainability, the purpose of this study was to evaluate how 4IR in general and its technologies have affected manufacturing SMEs in Durban. Furthermore, it also draws conclusions from explicit findings of this research in the implications section (5.3), to ascertain the awareness of 4IR, factors that influence this awareness, the level of technology acceptance, as well as the general perception on 4IR.

Even though these results highlight a restricted use of 4IR due to associated costs and dangers, positive themes such as improved and connected systems, better business processes, corporate growth, and transformation were dominant from participants. This revealed a comfortable understanding of 4IR. Given that 4IR is more frequently linked to opportunities than threats, this satisfactory understanding has facilitated a favourable outlook on 4IR by Durban-based manufacturing SMEs. It also highlights recommendations to Durban-based manufacturing SMEs and future studies to the body of SMEs. Based on the objectives, the reviewed literature and anticipated implications, this study recommends that manufacturing SMEs should prioritize education and training, innovate their business models to accommodate policy review and development in line technological disruptions, innovation, research and development, and smart infrastructure and investment. Finally, this chapter suggests that SMEs in different industries do comparable studies to determine the effects of

4IR. The results further support a proposal for a study that evaluates the effect of Covid-19 on the use of 4IR by manufacturing SMEs in Durban.

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Annexure A: Consent Letter

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mlondi Eugene Khuzwayo, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Mlondi Eugene Khuzwayo	06 July 2019	12h58	_____
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, Mlondi Eugene Khuzwayo herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Mlondi Eugene Khuzwayo	06 July 2019	_____
Full Name of Researcher	**Date**	**Signature**

Full Name of Witness (If applicable) **Date** **Signature**

_____ _____

Full Name of Legal Guardian (If applicable) **Date** **Signature**

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level - use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counseling (Department of Health, 2004)

If the potential participant is unable to read/illiterate, then a right thumb print is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. wrong date or spelling mistake a new document has to be completed. The incomplete original document has to be kept in the participant file and not thrown away and copies thereof must be issued to the participant.

References:

Department of Health: 2004. *Ethics in Health Research: Principles, Structures and Processes* http://www.doh.gov.za/docs/factsheets/guidelines/ethnics/

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Annexure B: Structured interview questions

RESEARCH INSTRUMENT

My name is Mlondi Eugene Khuzwayo, and I am currently studying towards my Masters in Management Sciences, specializing in Business Administration with the Durban University of Technology. The title of my research is: An assessment of the impact of fourth industrial revolution and its implications among manufacturing Small and Medium Enterprises owners/managers in Durban, KwaZulu-Natal province. I hereby invite you to participate in my study. Your responses recorded are anonymously and the strictest of confidentiality is guaranteed. You may withdraw at any stage should you wish to.

SECTION A: BACKGROUND INFORMATION

1. Please provide background information of the business owner/manager of your enterprise.

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2. Can you briefly tell me more about yourself in terms of Gender, age, education and industry experience.

SECTION B: QUESTIONS

Research Objective 1: To ascertain the level of awareness of the fourth industrial revolution among manufacturing SMEs in Durban, KwaZulu Natal.

3. What is your understanding of the concept fourth industrial revolution?
4. How do you think this concept has manifested in the 21st century?
5. What is your take on the approach of digital transformation and technological use?
6. In the manufacturing sector, how do you define a digital transformation process that makes business sense?

Research Objective 2: To determine factors that influence the awareness of the fourth industrial revolution among manufacturing SMEs in Durban, KwaZulu Natal.

7. What factors have influenced the rise and awareness of the fourth industrial revolution within your SME?
8. What risks and opportunities does technology create for the enterprise up and down the value chain?
9. On a general sense, what does the fourth industrial revolution entail for the manufacturing sector in Durban, KwaZulu Natal?
10. How is your work changing as a result of new technology that comes with big data, robotics and AI? Can you provide examples of where your enterprise today is adapting and implementing new technology effectively to deliver projects successfully?

Research Objective 3: To ascertain the level of technology acceptance among manufacturing SMEs in Durban, KwaZulu Natal.

11. For your firm, what is the level of technological use towards achieving your intended objectives?
12. With developing technology in the manufacturing sector, how is technology usefulness perceived in your firm, and how these changes are incorporated?
13. How would you perceive the ease of use of developing technology in your firm by employees?
14. How is the firm's purpose, vision and strategy needed to evolve for the digital age?

Research Objective 4: To identify the general perception on the fourth industrial revolution among manufacturing SMEs in Durban, KwaZulu Natal.

13. How do you expect the 4IR to affect the manufacturing profession over the next 5-10 years in South Africa?
14. How could the manufacturing profession accelerate its adoption of new technology?
15. Does the manufacturing profession have the skills and knowledge needed to deliver value to SMEs as they transform and adopt 4IR technologies?

16. Can the manufacturing profession work effectively with technologists and business decision- makers to provide the leadership needed?

Annexure C: Ethical Clearance

MANAGEMENT SCIENCES: FACULTY RESEARCH ETHICS COMMITTEE (FREC)

8 May 2020

Student Name: **Mr M Khuzwayo**
Student No: 21241614

Dear Mr M Khuzwayo

MASTER OF MANAGEMENT SCIENCES: BUSINESS ADMINISTRATION

TITLE: Assessing the impact of the Fourth industrial revolution on manufacturing SMEs in Durban, South Africa

Please be advised that the FREC Committee has reviewed your proposal and the following decision was made: **Approved – Ethics Level 2**

Date of FRC Approval: 8 May 2020

Approval has been granted for a period of two years from the above FRC date, after which you are required to apply for safety monitoring and annual recertification. Please use the form located at the Faculty. This form must be submitted to the FREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the FREC according to the FREC SOP's.
Please note that ANY amendments in the approved proposal require the approval of the FREC as outlined in the FREC SOP's.

Yours sincerely

Prof JP Govender
Chairperson: Faculty Research Ethics Committee