AN ANALYSIS OF FOURTH INDUSTRIAL REVOLUTION (4IR) AND ENTREPRENEURSHIP IN SOUTH AFRICA: OPPORTUNITIES AND CHALLENGES

By

Tshembo Ngomana

16015894

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Supervisor: Dr L.G Nkondo

Co-Supervisor: Dr A.I Nemushungwa

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DECLARATION OF WORK AND COPYRIGHT

I, Tshembo Ngomana, hereby declare that the dissertation titled - **"An analysis of Fourth Industrial Revolution (4IR) and entrepreneurship in South Africa: Opportunities and challenges"** - for the Master of Commerce in Business Management at University of Venda, is my original work and has not previously been submitted to this or any other institution of higher education. I further declare that all sources cited are indicated and acknowledged by means of a comprehensive list of references.

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DEDICATION

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ABSTRACT

Africa and the rest of the world have witnessed plethora of changes in the way we do things, by the introduction of the fourth industrial revolution. This is not just true for the way people live, for the fourth industrial revolution has also impacted the manner in which businesses operate and perform. Its introduction presented changes, challenges and opportunities on the operations of small businesses; these have not been sufficiently tested in the body of knowledge. It is against this background that this study investigates the changes, challenges and opportunities brought by the 4IR on entrepreneurship with special focus on small businesses. The study was guided by the radical humanists' paradigm, the phenomenological design and the qualitative research method. Data was collected from 10 small business owners purposively sampled from Gauteng at the Ekurhuleni Local Municipality and Mpumalanga at Bushbuckridge Local Municipality. A structured interview guide was used to collect data through face-to-face interviews while an audio recorder and a notebook were used to capture the responses of the participants. The collected data was transcribed using Microsoft Word version 26 and analysed thematically. Results indicate the fourth industrial revolution applicable technologies, potential changes, challenges and opportunities facing small businesses and entrepreneurship. The value of this dissertation is that it is among the first studies contributing towards understanding of the changes, challenges and opportunities presented by the 4IR to small businesses and entrepreneurship in South Africa. The scope of the study was restricted to Bushbuckridge Local Municipality and Ekurhuleni Local Municipality; therefore, findings might not be generalisable to other areas in South Africa, to the rest of Africa or other developing countries/emerging economies. There is an opportunity to conduct similar study with other municipalities in other provinces in South Africa to gain different views. The researcher recommended that entrepreneurs should search for more information from relevant and reputable sources in order to avoid misinformation and misunderstandings as well as enrolling on 4IR education and skills programme and policymakers should implement necessary tech-related policies that will work towards providing adequate tech-support to small businesses.

Key words: *Fourth industrial revolution, entrepreneurship, small businesses, potential changes, opportunities, challenges*

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LIST OF ACRONYMS AND ABBREVIATIONS

4IR	:	Fourth Industrial Revolution
CPS	:	Cyber-Physical Systems
IoT	:	Internet of Things
3D	:	Three dimension
UPS	:	Uninterrupted Power System
UTAUT:		Unified Theory of Acceptance and Use of Technology

CHAPTER 1: INTRODUCTION AND BACKGROUND OF STUDY

1.1 Chapter overview

This chapter introduces the study by outlining the literature on background of the fourth Industrial revolution (4IR), the research problem, aim, objective and questions. The significance of the study, delimitations and the methodology used to answer the main research questions are clearly discussed in this chapter.

1.2 Introduction and background

Industrial revolutions can be explained as periods in modern human history where technological innovation led to a radical shift in the socio-economic status of people. The global economy has undergone three major industrial revolutions, and is currently in the fourth stage (DTI, 2018). Each industrial revolution have been characterised by a succession of innovative approaches that have radically changed the traditional industrial approaches of its time, the ways of life as well as the individual's role in society (Kravchenko and Kyzymenko, 2019).

Xu, David and Kim (2018) in their study gave a brief history of the industrial revolution; they established that the first industrial revolution, began in 1760 until 1840 with the invention of the steam engine, which fuelled the conversion from farming and feudal society to a new manufacturing process. The second industrial revolution, which began in the late 19th century, was characterised by the invention of the internal combustion engine. This technology led to rapid industrialisation as well as mass production powered by oil and electricity. The third industrial revolution, which began in 1960 and was characterised by the introduction of electronics and information technology to automate production, marked a turning point in manufacturing.

Building from the third phase, the fourth industrial revolution (or simply the 4th industrial revolution, 4.0 or 4IR), come into existence in 2016 and involved computer-generated product design and three-dimensional (3D) printing, which can create solids object by building up successive layers of materials. Its implementation, amongst others, includes -robotics, artificial intelligence systems, automation, and introduction of cyber-physical systems (Xu, David and Kim, 2018). The fourth

industrial revolution is, therefore, a digital revolution that has been in existence since the middle of the last century, and is characterised by a combination of technologies that are narrowing the gap between the physical, digital, and biological spheres (Prisecaru, 2016; Kravchenko and Kyzymenko, 2019).

Unlike the three previous industrial revolutions that were technical innovations driven, the 4IR is influenced by the internet and allows communication between humans and machines in Cyber-Physical Systems (CPS) through large networks. It makes it possible to coordinate the collection and analyses of different data sets across machines, allowing faster, more efficient and more flexible processes to manufacture goods of higher quality at reduced cost (Bondar, 2017**;** Kravchenko and Kyzymenko (2019)**.**

Hermann, Pentek and Otto (2016) define industry 4.0 as a collective term for technologies and concepts of value-chain organization. A study conducted in Germany by Slusarczyk (2018) showed that the 4IR the 4IR which is associated with smart technologies that are responsible for decision-making processes increasingly rational and less biased through data compiled overtime, has brought about significant changes in the entrepreneurial arena. Organisational operations are realising better and continuous improvement due to the use of smart technologies through the implementation of custom systems, introduction of advanced gadgets and software updates that assist with unlocking even more functionality out of any existing products and systems (Osborne & Frey, 2016). Slusarczyk (2018) further argues that industry 4.0 has brought about a positive contribution on the business operations and the industry altogether.

1.3 Problem Statement

Unlike the advanced countries which have been gearing themselves for the fourth industrial revolution, the phenomenon has come as a shock to some African countries (Slusarczyk, 2018); likewise, South Africa is not an exception. This brings the question as to whether South Africa is also preparing itself for this industrial revolution, what are the 4IR technologies applicable to small businesses and the potential changes, challenges, and opportunities this will bring to the country's small businesses.

Literature is inconclusive on the impact of the 4IR on small businesses. There are those who believe it would have significant benefit for the industry (for example, Slusarczyk, 2018) whilst others argue that the notion of 4IR is detrimental to small businesses and to nations like South Africa; amongst the latter are Gillward (2019) and Baskin & Schiolin, (2019). Considering 4IR as an imposed global template, researchers stress that a developing country like South Africa needs appropriate technologies and ideas, not the imposition of global templates like the 4IR. The question whether the 4IR is a good notion or not, and how it would impact entrepreneurship initiatives, is still a contentious issue, particularly for businesses in South Africa. The current study will, therefore, contribute to this continuing debate.

Previous literature has specifically focused on the impact of the 4IR from an economic perspective (Gillwald, 2019; Baskin & Schiolin, 2019) thus, how it would impact the economic initiatives of countries, although scholars like Slusarczyk (2018) have focused on the reality of the 4IR in the industry, in general. These debates are ongoing as the notion has not been fully addressed in the body of knowledge, for instance, its impact on entrepreneurship. The 4IR technologies applicable to small businesses, potential changes, challenges and opportunities they would bring to small businesses, hence, have not yet been adequately addressed in academic literature. This study will, therefore, help to fill the dearth of information in academic literature on this topic.

1.4 Aim and Objectives of the study

1.4.1 Purpose of the study

This study aims to investigate the fourth industrial revolution (4IR) applicable technologies, potential changes, challenges and opportunities brought about by the fourth industrial revolution on entrepreneurship in South Africa.

1.4.2 Specific Objectives

i. To identify the fourth industrial revolution technologies that are applicable to small businesses in South Africa.
ii. To determine the potential changes that the fourth industrial revolution can bring about on entrepreneurial initiatives of small businesses in South Africa.

iii. To examine the challenges and opportunities that could be presented by the fourth industrial revolution's technologies on small businesses' operations in South Africa.

1.5. Research questions

RQ1: What are the fourth industrial revolution technologies applicable to small businesses in South Africa?

RQ2: What are the potential changes that the fourth industrial revolution can bring about on entrepreneurial initiatives of small businesses in South Africa?

RQ3: What challenges and opportunities could the fourth industrial revolution technologies present to small businesses' operations in South Africa?

1.6 Significance of the study

The findings of the study would primarily benefit small businesses' entrepreneurs as they would provide an understanding of the technologies that are specifically applicable to small businesses. Such an understanding will ensure that entrepreneurs operating small businesses acquire relevant technologies that will enable adaptability and long-term sustainability in the new business arena. Specifically, the findings of the study will provide an understanding of the challenges and opportunities that could be presented by the 4IR technologies to small business's operations. It is therefore necessary to carry out this study that investigates the 4IR technologies applicable to small businesses as well as any potential changes, challenges and opportunities which would be brought about by these technologies among businesses operating in South Africa.

1.7 Delimitations of the study

The study focused on 4IR technologies applicable to small businesses, potential changes, challenges and opportunities they would bring about on entrepreneurship in South Africa. The target participants of the study were entrepreneurs who are operating small businesses.

1.8 Definition of key terminologies

In this section are brief explanations of key terminologies used in this study.

1.8.1 Fourth Industrial Revolution (4IR) or Industry 4.0

The Industrial Internet Consortium (2013) defined the fourth industrial revolution (4IR) as the incorporation of complex physical machinery and advance devices which include connectivity sensors and software, all used to facilitate forecasting, controlling and planning to ensure that the desired business and societal outcomes are achieved. Lasi *et al.* (2014) defined the 4IR as a collective term representing a variety of new technologies, along with numerous linked disciplines within industry.

1.8.2 Entrepreneurship

In a study conducted in South Africa, Kew (2017) noted that there is a universal debate in defining what entrepreneurship is. A study conducted by Hitt *et al.* (2002) summarised a few definitions from other scholars such as Kirzner (1973), Drucker, (1985), Stevenson, Roberts & Grousbeck (1985), Rumelt (1987), Low & MacMillan, (1988) and Gartner (1988) who defined entrepreneurship as the act of creating a new business or the ability to perceive new opportunities.

1.8.3 Challenges

Scholars such as Richards & Schmidt (2013) defined challenges as conditions or circumstances that test the level of strength, ability, especially in an interesting manner.

1.8.4 Opportunity

Opportunity is defined as the subject of discovery or creation (Oyson, 2016). Similar views by Oyson and Whittaker's (2015) defined an opportunity as a situation which is discovered or created. Following the views of other scholars, the study defines opportunity as a chance to exploit or create something new.

1.8.5 Small Business

Due to several definitions that are currently in place, Anderson (2011) argued that in defining what a small business is, there is an on-going debate and that each definition is valid in its own context. This means that there is no universal definition of a small business, however, the South African National Business Act of 1996 defines a small business as:

"..a separate and distinct business entity, including co-operative enterprises and nongovernmental organisations, managed by one owner or more which, including its branches or subsidiaries, if any, is predominantly carried on in any sector or sub sector of the economy mentioned in Column I of the Schedule14... "

1.9 Literature Review

The aim of this literature review is to ascertain 4IR technologies applicable to small businesses, as well as potential changes, challenges and opportunities which could be brought about by the revolution (4IR) among small businesses. The review will outline the 4IR technologies applicable to small businesses, the potential changes that digital transformation can bring about in the entrepreneurial initiatives of the small businesses and the challenges and opportunities presented by the 4IR technologies on small businesses' operation. The technologies, potential changes, challenges and opportunities are discussed hereunder:

1.9.1 Fourth Industrial Revolution Technologies applicable to Small Businesses

In order to ensure the long-term survival of small businesses, it is imperative to identify industry 4.0 technologies that are applicable to them. For example, technologies such as 3D printing has been identified as being effective in enabling entrepreneurs with new ideas to start operating small businesses, at a very low cost (Xu *et al.,* 2018). A study conducted in Africa by Naud (2019) posited that the transformation brought about by the 4IR new technologies presents promising opportunities. This, for example, could be due to businesses' improved ability to provide quality, high productivity job opportunities in urban areas, to enhance the development of human capital and to provide increased levels of production for small businesses.

The new technologies brought about by the fourth industrial revolution (4IR) includes - improvements in the internet of things (IoT), advanced resources or materials, advanced digital platforms, robotics, artificial intelligence, improved interface of Things and advanced data analytics, which increases mass customization through the use of new 3D printing and changes in the business models such as sharing and on-demand economies (Naud, 2019). These technologies are suitable for improving

manufacturing processes, and increasing accessibility levels, especially for small businesses and artisans operating in Africa (Naud, 2019). These results concur with those of a study conducted in Pakistan by Muhammad *et al.* (2018) which concluded that new technologies brought about by the 4IR were able to resolve a variety of the issues. These researches further mentioned technologies such as the Internet of things (IoT), big data, smart factory, and cyber security.

1.9.2 Potential changes brought about by the 4IR in the entrepreneurial initiatives of small businesses

Scholars such as Xu, David and Kim (2018) point out that changes that can be presented by the 4IR should not be left unexplored, as they may result in a shift in power, wealth and knowledge. This complements the findings from a study conducted by Prisecaru (2016) who mentioned a few changes, such as (i) for connectivity, learning, and exchange of information, as majority of people, globally are more likely to rely on the use of social-media platforms, (ii) the quality and price of good and services of many innovative producers will improve as a result of an increase in the level of accessibility to the digital platforms of marketing, sales, and distribution, (iii) there will be a significant increase in the level of customer or consumer involvement in the production and distribution chains.

Xu, David and Kim (2018) postulated that the main effects brought about the 4IR in the business arena are the influences it will have on the expectation of consumers, the quality of the products, the drive towards collaborative innovation, and the forms of organizational innovation.

1.9.3 Challenges and Opportunities presented by the 4IR technologies to small business' operation

The emergence of the new revolution brings with it many opportunities and also challenges. A study conducted by the Council, Commission and Women (2017) acknowledged that new production practices caused by the emergence of innovations lead to global reshaping of economies, and consequently presenting opportunities and challenges to the African decision-makers or entrepreneurs.

1.9.3.1 Challenges

The world is faced with technological revolution which will fundamentally change our norms with regard to how we live, work and relate to one another, furthermore, the transformation will be far from anything humankind has experienced before, because of its scale, scope and complexity (Schwab 2015). This shows that the fourth Industrial Revolution (4IR) will not only present opportunities to people or businesses at large, however, the change will also present challenges. Roberto Mavilia & Roberta Pisani (2021) highlighted that in developing countries, the 4IR and concept of smart factory might introduce some challenges as they would allow significant reduction in waste and production costs, especially in particular labour costs.

The 4IR could present inequality because of its potential to cause disruption in the labour markets (Xu *et al.,* 2018). These authors gave an interesting explanation of the disruption in the labour markets; they explained that the disruption would be due to automation being a substitute for labour. This concurs with a study conducted by Wolf (2015) which noted that computers and digitalization will replace low-skilled and waged jobs while higher-paying jobs which require high-skilled labour will be less affected. Lambert (2017) identified variety of challenges presented to industry, by 4.0, such as hacking, demands on cyber-security and an assortment of risks. Other challenge has been identified in Sub-Sahara Africa by the WEF (2017) who mentioned that lack of adequate policy and general attitude towards technological innovation frameworks will hinder the full entrepreneurial participation in the fourth industrial revolution. A study conducted in South Africa by Oyebanjo and Tengeh (2021) indicated that SMEs are facing challenges such as requisite skills and adequate infrastructure to implement the 4IR.

1.9.3.2 Opportunities

Changes brought about by the fourth industrial revolution (4IR) into the business arena will not only present challenges, but also opportunities. Xu, David and Kim (2018) postulated that in the exploration of the 4IR, pioneer scholars had pointed out that the new revolution through its impact, will not only shape the future of the government, however, it will also shape the future of businesses. They predicted that industry 4.0 will present the following opportunities, (i) a decrease in the barriers between the market and investors; (ii) an increase in the level of activities facilitated

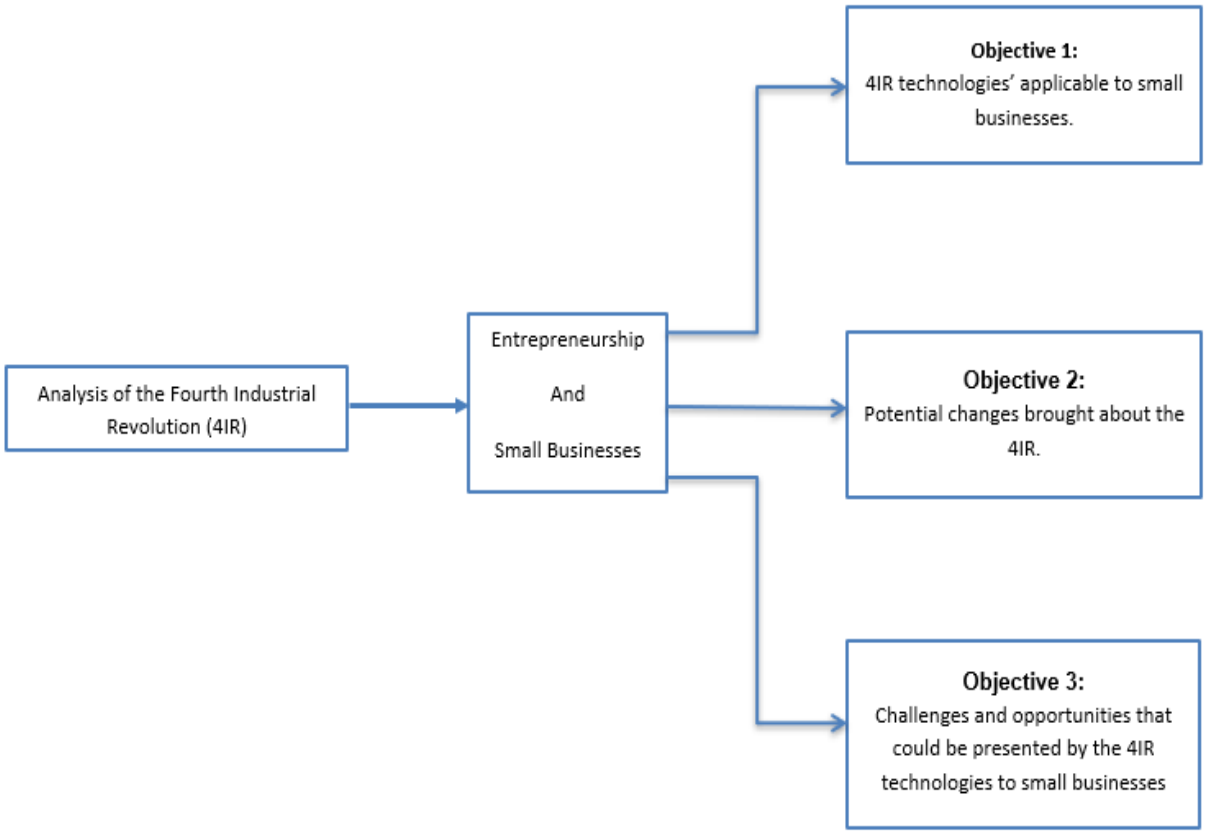
by the artificial intelligence (AI); (iii) integration of different technics and domains (fusion); (iv) an improvement in the standard of living through the utlisation of robotics and (v) an increase in the level of connectivity (Xu *et al.,* 2018). The 4IR has potential to introduce more opportunities to the SMEs in South Africa by helping entrepreneurs improve their businesses through the use of innovative and advanced technologies (Millington, 2017). Petrillo *et al.* (2018) highlighted that the 4IR will result in the improvement of production efficiency and flexibility of business operations.

1.9.3 Proposed conceptual framework

Oke & Fernandes (2020) highlighted many 4IR applicable theories used by scholars, such as the theory of planned behaviour (TPB), the diffusion of innovation theory, and the technology acceptance model (TAM). These theories have been used in empirical studies to gain an understanding of technology adaptation by people and to measure the likelihood of accepting and putting the technologies into use. To effectively answer the research problems and research questions, the study adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) in order to determine whether entrepreneurs operating small businesses do accept and make use of the 4IR technologies applicable to them; in addition, whether entrepreneurs also understand the opportunities, potential changes and challenges that may emerge as a result of accepting and using the 4IR technologies.

A conceptual framework was also developed for this study in order to effectively resolve the research problem and questions. The aim of this conceptual model was to provide a premise regarding the applicable 4IR technologies, potential changes, challenges and opportunities brought about by the fourth industrial revolution (4IR) or Industry 4.0 on entrepreneurship and small businesses in South Africa. Figure 1.1 below is a conceptual framework depicting the intended impact of the fourth industrial revolution (4IR) on entrepreneurship and small businesses. The framework also highlighted the problem statement which stemmed from an identification of the impacts of 4IR. The three objectives that the study seeks to resolve were also depicted in the framework.

Figure 1.1 Conceptual framework



Source: Researcher's own construct

1.10 Research Methodology

The study was conducted at Ekurhuleni Local Municipality in Gauteng and Bushbuckridge Local Municipality in Mpumalanga. The purpose of the study was to investigate 4IR technologies applicable to small businesses, as well as potential changes, challenges and opportunities which would be brought about by the fourth industrial revolution (4IR) on entrepreneurship in South Africa. It was imperative to conduct the study in different provinces in South Africa in order to develop an understanding on how entrepreneurs from different locations are experiencing the new revolution.

The researcher adopted the phenomenological research design in order to investigate the 4IR technologies applicable to small businesses, and the potential changes, challenges and opportunities brought about the fourth industrial revolution (4IR) on entrepreneurship in South Africa. A qualitative methodology was adopted for this study. This methodology was utilized to achieve study objectives, as little is known about the 4IR advanced technologies applicable to small businesses, and the potential changes, challenges and opportunities presented by the 4IR on entrepreneurs operating small businesses.

The target population of this study consists of entrepreneurs operating small businesses in the selected two municipalities. The study adopted a purposive sampling approach in order to select a relevant sample for the study. A total sample size of 10 small business owners participated in this study; participants represented both black and white entrepreneurs who have been operating for more than two years. The collection of data was done through structured interviews which were conducted, either face-to-face or virtual.

A thematic analysis was employed in order to comprehend the collected qualitative data. The form of thematic analysis adopted for this study was the Latent level or theme in order to effectively develop an in-depth understanding of the participants' views, assumptions on the 4IR applicable technologies, changes, challenges and the opportunities that they will bring amongst small businesses operating in South Africa. The comprehensive methodology followed by the study is thoroughly discussed in Chapter 3.

1.11 Outline of the dissertation

The dissertation consists of six (6) chapters, which are structured as follows:

Chapter One: The general overview of this study was highlighted in this chapter. This chapter, therefore, provided details on - the introduction and background of the study, research gap, problem statement, aims of the study, objectives of the study, research questions as well as, significance and delimitations of the study.

Chapter Two: This chapter deliberates on the available literature where the researcher seeks to understand what other scholars are saying about the 4IR's or industry 4.0's technologies applicable to small businesses, and their potential changes, challenges and opportunities which would be presented to small businesses or the entrepreneurial arena, Attention will be placed on both the international level and also the South African context.

Chapter Three: In this chapter, the focus is on how the study was conducted. Aspects outlined are the study area, research design, research paradigm, target population, sampling technique, data collection, data analysis, ways of ensuring trustworthiness, and the ethical consideration to be followed in conducting the study.

Chapter Four: This chapter consists of analysing and interpreting the collected data.

Chapter Five: A comprehensive interaction with the interpreted data will be carried out in this chapter. The findings will be compared to those of the past scholars, who either concurred, supported, found similarities or contradicted these findings.

Chapter Six: A summary of the findings, conclusions on the research questions and recommendations will be presented in this final chapter.

CHAPTER 2: LITERATURE REVIEW

2.1 Chapter overview

The chapter is organised as follows - Section 2.2 presents discussions on the fourth industrial revolution (4IR); Section 2.3 the fourth industrial revolution's (4IR) technologies applicable to small businesses; in section 2.4, potential changes presented by the fourth industrial (4IR) revolution in relation to entrepreneurial initiatives of small businesses are explained, while sections 2.5 and 2.6 examine the challenges and opportunities brought about by the fourth industrial revolution (4IR) to small businesses, respectively.

2.2 Introduction

This chapter investigates and presents an in-depth discussion of the impact of the fourth industrial revolution (4IR) on entrepreneurship. Aspects examined are the 4IR technologies applicable to small businesses and the potential changes, challenges and opportunities they bring to small businesses. The focus of this chapter is to investigate these factors in different geographical contexts, namely globally, in Africa and specifically, in South Africa.

2.3 The Fourth Industrial Revolution (4IR)

Fourth industrial revolution (4IR) which is also known as Industry 4.0, is defined by Imran, Hameed, and Haque (2018) as a name given to the latest automation and data exchange in several technologies. There are universal and transformative requirements for industry 4.0, such as codifying and programming, implanted into artificial intelligence (AI) systems, that will supplant and reshape human work practices (Lee, Yun, Pyka, Won, Kodama, Schiuma, Park, Jeon, Park, Jung, Yan, Lee & Zhao, 2018; Wessels, 2020). As argued by Schwab (2016), unlike its predecessors (the 1st, 2nd and 3rd), the fourth industrialisation revolution is characterised by technological advancements that have grown at an exponential rate. Industry 4.0 will undoubtedly have a significant contribution on all aspects of society as it will transform the environment within which organisations and their workforce operate (Kapp, 2018).

2.3.1 History of the Revolutions

The invention of the steam engine propelled the first industrial revolution in 1760, and it changed the ways of the feudal society and farming by introducing new manufacturing processes. While trains were facilitating transportation, the new manufacturing processes included the use of coals as the main source of energy. The most dominant industries regarding employment, output value and capital invested, were the textile and steel industries.

In 1900, a combustion engine, which allowed mass production and led to an era of rapid industrialisation, with the use of oil and electricity. This invention introduced the second industrial revolution.

The third industrial revolution emerged in 1960, with the invention of advanced electronic devices and information technology to automate and enhance production. The current inventions which include computer-generated product design and three - dimensional (3D) printing enables the introduction of the fourth industrial revolution (4IR) (Xu *et al.,* 2018). Table 2.1 below, adopted from a study conducted by Prisecaru (2016) summaries the discussed history briefly.

Table 2.1 History of the Industrial Revolution which is 1st, 2nd, 3rd and 4th IR.

Period	Transition Period	Energy Resource	Main Technical Achievement	Main Developed Industries	Transport Means
1760-1900	1860-1900	Coal	Steam Engine	Textile, Steel	Train
1900-1960	1940-1960	Oil Electricity	Internal Combustion Engine	Metallurgy, Auto, Machine Building	Train, Car
1960-2000	1980-2000	Nuclear Energy Natural Gas	Computers, Robots	Auto, Chemistry	Car, Plane
2000-	2000-2010	Green Energies	Internet, 3D Printer, Genetic Engineering	High Tech Industries	Electric car, ultra-fast train

Source: Prisecaru, P. (2016)

2.4 Fourth industrial revolution technologies applicable to small businesses

Small businesses have been identified by many scholars to be an excellent source of job creation, enhanced technological development and able to develop indigenous entrepreneurs (Erdem and Erdem, 2011; Alaye-Ogan, 2012). Many studies have emphasised the importance of small businesses in the economy and in the general standard of living of the people. Technological changes cause disruptions which can be experienced by many disciplines, namely, economies, government and industries (Bailey, 2018). Consequently, the knowledge of the 4IR or Industry 4.0 technologies applicable to small businesses will guide entrepreneurs in effective implementation of these technologies in their businesses and consequently yield good results and ensure long term sustainability.

The technologies applicable to small businesses in manufacturing industry as identified by Naudé (2017) includes the Internet of Things (IoT), Innovative materials, digital platforms, artificial intelligence (AI), big data analysis and 3D printing. The application of these technologies has resulted, for example, in small businesses formulating new forms of manufacturing processes such as small-scale manufacturing which now is more competitive and efficient.

An explorative study conducted in South Africa by Bailey (2018) revealed Internet of Things (IoT) as one of the technologies which assists interconnectivity that will enable Small, Medium and Micro Enterprises (SMMEs) to coordinate their products and services into the much larger global value chains. Brynjolfsson and McAfee (2012) identified “Robots-in-a-Box” which enables small businesses to create their own automated factory or environment of operation and consequently it results in a reduction of costs and an increase in the level of manufacturing flexibility.

2.4.1 The Internet of Things (IoT)

ECLAC (2018) defined Internet of Things (IoT) as a system of electronic devices, networks, software platforms and applications that enable sensors on physical objects to collect and disseminate information on other objects and their environments. The organisation elaborates that production level, maintenance predictions, manufacturing servicing, products assurances, flow automations, and production customisations are optimized by the IoT applications (ECLAC, 2018).

Scholars such as Radoglou *et al.* (2019) stressed that the Internet of Things (IoT) consists of many networks responsible for the coordination of communication between devices via the internet. These devices are also referred to as 'things' (Ahmad, 2021).

Alaba *et al.* (2017) argue that the Internet of Things (IoT) has created a global network of people, objects, sensors, and services. The primary goal of the Internet of Things (IoT) is to create a conducive environment which allows communication protocols, software, and the incorporation of physical/virtual sensors, personal computers, smart devices, automobiles, and other real-world objects to connect with each other at any time on any network (Ahmad, 2021). Nagy, Ol and Erdei, (2018) also elucidated that Internet of Things' (IoT) tools include technological elements that enable a product or a producing machine to access or share information from the corporate network.

2.4.2 Digital platforms

A digital platform can be defined as a technology-enabled business model that generates value by allowing two or more independent groups to interact and communicate (ECLAC, 2018). In a qualitative study done in Singapore by Li, Yun and Wu (2017), they pointed out that digital platforms have resulted in cost reduction of transactions and friction expenditure incurred when individuals or organizations share the use of assets or services. They found that digital platforms are easy to use on a smartphone, assets, to convene people, for data gathering and developing new ways of goods and services' consumption. De Reuver, Sørensen and Basole (2017) highlight that as digital platforms are currently transforming almost every industry; they are slowly finding their way into the mainstream information systems (ISs) literature.

2.4.3 Robotics

Robots are machines or systems that have the ability to accept high-level task-oriented commands and execute complex tasks in a semi-structured environment where the level of human intervention is very low (Deloitte, 2018). Robotics are applicable in industries that perform assembling and packaging-related activities and this also includes some industries that deals with welding. The use of robotics labour

in manufacturing industries has resulted in a dramatic reduction of costs and also enabled small businesses to set up their own automated environment (Brynjolfsson and McAfee, 2012).

With regard to robotics, Kirwan and Zhiyong (2020) mentioned that the symbiotic relationship between AI and machine-learning enables robots and autonomous systems to operate at a high level and manipulate physical objects far more efficiently than the normal human workforce, while ensuring continuous improvements and optimisation their performance over time. Advanced robotics, artificial intelligence (AI), and machine-learning technology allows providers to offer productivity services, effectively and efficiently (Wirtz *et al.,* 2018).

2.4.4 Biotechnology

Ereky (1919) defines biotechnology as the science and techniques that enhances the production process and allows products to be produced from raw materials with the assistance from living organisms. The author foresaw a time when biology could influence production and be adopted in the process of turning raw materials into useful products. Ereky invented the term ‘biotechnology’ to outline the merging of biology and technology. Biotechnology is a diverse field which involves either working with living cells or using molecules extracted from them for applications oriented toward human welfare using varied types of tools and technologies. It is a combination of biological science with engineering whereby living organisms or cells or parts are used for production and services (Gupta *et al.,* 2016).

A qualitative study conducted by Deloitte, South Africa (2018), assessed the opportunities and challenges that the digital transformation of industry 4.0 represents for South African businesses. They reported that the biotechnological system is employed in the production of essential commercials and biomolecules for medicines, food and beverages. This form of technology is applicable in industries such as pharmaceutical, recycling (bioplastic), renewable oils, clothing and textile, cellular agriculture and the food and beverage industry.

2.4.5 Artificial Intelligence (AI)

Artificial Intelligence is a scientific process of developing smart machines (Frey *et al.,* (2016). In a study to explore the possibility of 4IR becoming a window for the advancement of ASEAN economies along with how they should prepare for the 4IR to avoid being stuck in the MIT, Lee *et al*. (2018) gave a similar definition of Artificial Intelligence (AI). They looked at it as a cognitive science which entails different research areas, which include but is not limited to robotics, machine learning and image processing. Deloitte (2018) understood Artificial Intelligence (AI) to be the theory and production of computer systems that are able to execute activities that requires human intelligence.

2.4.6 3D-printing

Naud (2019) posited that 3D printing, also referred to as “Additive Manufacturing” makes use of laser printers to develop objects by printing thin layers of materials onto one another. The application of this 4IR technology introduced new forms of manufacturing such as small-scale manufacturing that has been seen to be more competitive and efficient through the use of elements that allows additive manufacturing, mass customization, cheaper automation and reduction of expenditures (Naude, 2017).

2.4.7 Interface of Things

The Interface of Things is made up of Virtual Reality (VR) which produces - a fully engage-able digital environment that substitutes for the user’s real-world environment; Augmented Reality (AR) which creates a connection between digitally-created content and the user’s real-world environment; Mixed Reality (MR) which effortlessly merges the user’s real-world and the digitally developed context and gesture recognition technology that allows interaction and communication between humans and machines (Deloitte, 2018).

2.4.8 Simulation

Bayode *et al.* (2019) stated that Simulation is a new technology introduced by the 4IR in the business environment. They defined it as a technique of execution model for safety and effecient solving of real-word problems, virtually. Klee and Allen (2018)

gave a behavioral element definition of Simulation as a technique employed to analyse the behaviour of complex systems. Xiang (2012) postulated that Simulation application has been introduced in various areas because of its demonstrated ability to improve elements of manufacturing systems (products, materials and ergonomic designs, energy consumption and manufacturing processes).

2.4.9 Cloud

The National Institute of Standards and Technology (NIST) defined Cloud as:

> *"a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."*

Cloud is known as an online interconnected global network remote servers that operate as a mono-ecosystem, furthermore, these servers are intended to provide different services such as managing data, processing and storage of data, (Bayode *et al.,* 2019).

2.4.10 Augmented Reality and Virtual Reality (AR/VR)

Augmented Reality (AR/VR) is an interactive technology that digitally introduces an object into the physical environment of the operator, while Virtual Reality effectively removes the users from their physical environment (Huang *et al.,* 2018). Bayode *et al.* (2019) add that these technologies have value-adding potential in various industries.

2.5 The potential changes presented by the fourth industrial revolution (4IR) in the entrepreneurial initiatives of the small businesses

Regarding changes brought about the introduction of Industry 4.0, Arntz, Gregory, & Zierahn (2016); Brynjolfsson & McAfee (2014); Ford (2015); Frey & Osborne (2017) amongst others, assert that Industry 4.0 is mostly considered to be a significant societal and economic trend and consequently brought so many changes in the nature of work, business and society. These potential changes are thoroughly explored hereunder.

2.5.1 Technological changes

Frey & Osborne (2017) conducted a quantitative study in the United State to examine how susceptible jobs are to computerization. They mentioned that in the past few centuries, changes in technology are depicted in three major industrial revolutions: (a) in the late 18th century, mechanical production emerged, (b) the late 19th century represents the introduction of mass industrial production, and (c) personal computers and the internet was also introduced in the 1960s.

Schwab (2016) established that the current changes that brought about the fourth industrial revolution are commonly characterised by key technologies, such as artificial intelligence (AI), cloud computing, 3D printing, genetics, nanotechnology and biotechnology. These technological innovations have result in drastic disruptions in the normal business operations (Oke, 2020).

There are rapid changes in technology which have consequently caused fundamental changes and more continuous technological breakthroughs (Brynjolfsson & McAfee, 2014; Ford, 2015). Technology ensures that small businesses adapt to the ever-changing environment and scholars such as Ghobakhloo *et al.* (2012) contend that small businesses usually use the ICTs because of internal factors, such as change of location, downsizing and capturing of new markets. Stankovska *et al.* (2016) posited that digital technologies are becoming more affordable and accessible and as a result, the communication, marketing activities and interactions in the marketplace have changed; these changes have enhanced the level of technological adoption by the SMEs. Brown and Keep (2018) believed that due to technological changes, the workplace will be dominated by three different factors: shortages in the skills, job shortages, and job cessation.

2.5.2 Structural changes

Structural changes refer to those that occur in the organisational structure. Scholars such as Autor & Dorn (2013); Goos, Manning, & Salomons (2009) maintain that technological changes have resulted in job polarisation in the United States and the European markets. Job polarisation is a situation whereby middle-skilled jobs are phased out while the low-skilled and high-skilled jobs remain in existence, however, increasing at a disproportionate rate (Hirschi, 2018). Similar findings from a study

conducted by Ford (2015) highlighted that fear presented by technological changes focuses on automation, robots and work being performed by humans, being lost. Ślusarczyk (2018) identifies the structural changes presented by technological breakthroughs in the organization of production; the research established that there is a need for entrepreneurs to adapt to these changes and implement technologies that will ensure the sustainability of their small businesses. Pansiri and Temtime (2010) posit that, it is imperative for small businesses to be aware of the nature of the environment under which they operate and the anticipated environment and most importantly, the need to incorporate changes in their ways of formulating and implementing their strategies.

2.5.3 Business model adjustment

With regard to business mode adjustment, scholars such as Li, Yun and Wu (2017) note that the emergence of new products, through technology leaders, has resulted in a great change in customer expectations about how products should be. The changes in the expectations will result in businesses altering their current state of operations or business models and introducing strategy adjustments in order to effectively overcome challenges presented by the new technology.

A study conducted by Acatech (2014) explained that Internet of Things (IoT) will result in the transformation or change in the way in which products are produced, the logistics and the work processes. As a result of technological changes, businesses are expected to make adjustments to their business models to become more innovative and employ flexible value chains as a way to respond to any changes in consumer behavior (Morrar *et al.,* 2017). This means that it is crucial for small businesses operating in South Africa to continuously adjust their business models in line with changes presented by the 4IR.

2.5.4 Change in performance

With regard to changes in performance, Hahm (2018) conducted a study in Korea to examine how specific attitudes to main components improve performance-related factors for 4IR. It was found that changes in workers' performance depend on a specific main component of the fourth industrial revolution (4IR), hence, performance may be different throughout the 4IR era. This view is supported by Moshiri and

Simpson (2011) as they pointed out that changes in individual and organizational performance can be dramatically influenced by advances in IT which may lead to business organization transformations, fostering of innovation and increased competition.

2.6 The challenges and opportunities brought about by the fourth industrial revolution (4IR) on small businesses.

The Fourth Industrial Revolution is inevitable, and it brings with it changes which may pose new challenges and opportunities in the entrepreneurial arena and small businesses' operations. In a study conducted by Hahm (2018), the scholar predicted that the 4IR is coming, therefore, the world needs to prepare for the challenges it will present while also taking advantage of the opportunities it will introduce. Scholars, such as Petrillo *et al.* (2018) postulated developed and developing countries may face different challenges in the 4IR implementation process.

Developed countries may face challenges such as the requirements for experimentation and learning to provide a way for companies to strengthen their businesses, address data explosion in order to effectively send more information in a quick way. This will, consequently increase the data volume, transformation the workforce and create a tech-conducive working environment. The developing countries, on the other hand, may be faced with challenges such as training of operators with specific skills in managing digital jobs and the acquisition of funding to start planning at the national and regional level for the implementation of the 4IR (Petrillo *et al.,* 2018). The challenges and opportunities brought about by Industry 4.0 are discussed in-depth hereunder:

2.6.1 Cyber-Security challenge

Petrillo *et al.* (2018) conducted a study to present the main good practices, challenges, and opportunities brought about the 4IR. They found that security of computer data is a challenge; researchers predict that many companies may face this challenge in ensuring the safety of their operations, avoiding leaks that might hinder their competitive advantage and the loss of confidential information about major customers. This finding concurs with those of Bakhtari, and Mannan (2018) who mentioned three forms of cyber-security challenges that are part of current

reality - cyber-terrorism, cyber-crimes and hacking – and these may hinder the implementation process of Industry 4.0. These views were supported by Bakhtari *et al.* (2020) who mentioned that - hacking, cyber- terrorism and cyber-crime are the realities that may pose a barrier towards the implementation of Industry 4.0.

Other scholars such as Yang *et al.* (2019) add that privacy in Cyber-Physical System (CPS) is strongly inactive; they continue by pinpointing two ways of privacy leaking in CPS: (i) physical- a privacy attack aimed at destroying physical properties of the system, (ii) cyber- these are attacks that are associated with computer virus, network and software-based attacks.

Shava & Hofisi (2017) inform that an international cyber security organisation, Palo Alto Networks, held a conference in Tokyo on 7 June 2016, where it acknowledged that Cyber crime is a possible threat to the fourth industrial revolution (4IR) as it affects changes in legislations and the intelligence structures of countries.

2.6.2 Usability - The Human Factor Various

A study conducted in Germany by Waidner and Kasper (2016) revealed that various forms of 4IR have been implemented, such as lean production and collaborative engineering. The scholars added that knowledge of potential threats, risks and available security solution are lacking in small and medium-sized businesses and as a result, this may lead to the emerging of security challenges in the production sector. Acknowledging the opportunities presented by the 4IR with the production sectors, such as flexible and more self-determined approaches of work, however, operational challenges may also emerge from the introduction of a new way of working, other workers may find the new machines and systems very challenging to use. A report from the World Economic Forum (2016) established that the 4IR if it is not regulated can reduce the functioning of human capacities and among other things, compassion and cooperation.

2.6.3 Legal Certainty and Data Protection challenge

The fourth industrial revolution (4IR) did not only introduced opportunities, but also future uncertainties in legal matters and data protection. Waidner and Kasper (2016) point out another form of challenge which is not technological related, namely, the

legal aspect. The authors noted that legal and judicial mandatories need to be taken into consideration from the beginning to avoid legal complications and liability risks which may disrupt the development and application of the 4IR concept. Due to unclear legal framework of conditions overseeing self-organizing and service-oriented production platforms, additional demands may arise in the 4IR. Shava and Hofisi (2018) support these views by asserting that the 4IR is leading to an alarming rate of changes which ultimately may result in legislators adopting and being highly innovative to accommodate these new technologies.

2.6.4 Job market disruption

Another change brought about the 4IR is the disruption or inequalities in the job market. Prisecaru (2016) quoted Anders Borg - a Swedish economist and politician - who contend that changes in technology spheres of digital work, connectivity, availability of big data and robotics will disrupt the labour market. The scholars mention that in cases where disruption takes place due to robotics and digitalization, other factors such as tax revenues and tax labour income in the long run will decrease, public pension fund will be impacted and there is a possibility that the social costs of taxes will increase as a result of loss of jobs and lower GDP.

Coleman (2016) supported these views by explaining that employing robotics and artificial intelligence (AI), quantum computer, sensors and nanotechnology decreases human labour which consequently result in a disruption of household income. The author contends further that, the introduction of the artificial intelligence (AI) will result in a reduction of the skills set as there will be few specialists participating in the implementation of exponential technologies which will only create opportunities for those with the relevant skills set.

A study conducted in Poland by Wyrwicka & Mrugalska (2017) concurs with these scholars by asserting that the introduction of the 4IR new technology areas will demand new skills set from specialits employees. Bakhtari *et al.* (2020) mentioned loss of employment as a result of the new 4IR whereby low-skilled employees will be replaced by computers and digital transformation which will consequently increase social tensions and pessimistic ideas against such implementation.

2.6.5 Funding Challenges

The implememtation of the Fourth Industrial Revoltion comes at a cost to small businesses. Petrillo *et al.* (2018) pointed out that the need for implementation funding is one of the major challenges at the national or regional levels. Similar views were shared by Moeuf *et al.* (2018) who mentioned lack of funding as one of the major barriers faced by small to medium-scale enterprises (SMEs) when attempting to adopt new technologies.

Following the views of these scholars, it is important to anticipate that many small businesses operating in South Africa will be faced with financial challenges when planning and implementing the relevent new 4IR technologies.

2.6.6 Social Pressure

The 4IR new technologies can have a negative impact on broader society as a result of its increased vulnerability to global shocks, intrusive state surveillance, social pathologies and more cyber-security crimes (Townsend, 2016). Social perceptions and beliefs are usually, against connectivity through the Internet of Things (IoT) since it poses a threat to customer privacy (Bakhtari *et al.,* 2020).

A survey study done in Kenya by Bongomin *et al.* (2020) revealed that cyber-attacks and low connectivity pose great threats to Internet of Things (IoT) applications. These scholars contend further that the new 4IR technologies have the potential to cause broader societal changes by transforming the current economic sectors, production and the levels of consumption. Following the views of these scholars, it is evident that the academic debate as to whether the fourth industrial revolution (4IR) is a good or bad notion may pose social negativity amongst small businesses operating in South Africa.

2.6.7 Lack of adequate skills and training challenge

Bakhtari *et al.* (2020) mentioned training of operators with new or relevant skills and transforming the workforce to enable them to effectively execute required activities digitally as some of the weakness posed by the 4IR. A study conducted by Naudé (2018) posed a very pertinent question - “Will the 4IR by-pass Africa due to lack of skills?”, Following this question, the scholar speculates that the 4IR by-passing

African countries due to lack of adequate skills and ICT infrastructure to employ these technologies is the first threat. Industry 4.0 in parrticular has a higher demand for tehnological skills and these are in short supply in African countries. Frey *et al.* (2016) stress that technological skills are critical for the 4IR. Banga and Velde (2018) testify to an increase in the percentage of businesses suffering from skills shortage and most significantly a shortage of digital skills in many African countries.

The WEF reported, on the *"The Future of Jobs and Skills in Africa"*, that African countries have not properly prepared for any sudden disruption to employment and skills as a result of the 4IR (Leopold, Ratcheva and Zahidi, 2017). Looking at the South African context, Schwab (2017) pointed out shortage of skills as one of the challenge that has been massively faced by the country for many years, especially in high technology areas, such as engineering and Information Communication Technology (ICT); South Africa is currently ranked 69th globally in terms of human resource.

2.6.8 Broadband and ICT Infrastructure challenge

As pointed out by Moeuf *et al.* (2018), South Africa's fixed broadband and wireless infrastructure is arguably one of the best in the African continent, however, there is limited access to fixed broadband like Fibre since it is inaccessible to a large number of the population, as a result of its limited penetration and affordability. The also mentioned that even though mobile internet has a higher penetration rate, the challenge of higher-priced data costs limits the access. As argued by Deloitte (2016), South Africa' factories have old IT and industrial equiment, including machines from various manufactures and these old current systems are typically not complying with the Industry 4.0 environment.

2.7 Opportunities brought about by the fourth industrial revolution (4IR) to small susinesses

Like the previous revolutions, the fourth industrial revolution (4IR) has the potential to improve the standard of living and global quality of life for the population at large since the new technologies have presented growth opportunities such as the development of new products and services (Schwab, 2016). In order to examine the relevance of the 4IR-related opportunities and challenges as the driving force of

Industry 4.0 implemantion, Müller *et al.* (2018) conducted a study in Germany which concluded that for large corporations, mechanical and electrical engineering manufactures, strategic opportunities are the main antecedents of the 4IR implementation. For small and medium-sized (SMEs) businesses in industries such as automation, chemical, plastic and steel manufacturing, these however, are driven by operational opportunities.

Bayode *et al.* (2019) mentioned significant benefits brought by Industry 4.0 to manufactures such as - enhanced quality of product, increased turnover, support for innovation across many applications, reduction of waste, increased flexibility, energy-efficient and environmentally-sustainable production and enhanced safety in the work settings. The opportunities brought about the 4IR or Industry 4.0 are discussed in detail hereunder.

2.7.1 Informatization of manufacturing process

Li *et al.* (2017) inform that informataisation of the manufacturing processes comes as a by-product of the new Fourth Industrial Revolution, which had comprehensively introduced new ways of manufacturing and that this new concept puts more emphasises on equipment, distribution, control independence, as well as equipment connection, via networks. These scholars add that the new production model introduces the capacity for small businesses to maximise the levels of production and also encourages innovative ideas.

2.7.2 Creation of new positions and businesses

Reports such as the OED (2020) working paper note that 14% of jobs are at high risk of being replaced by automation, 32% are in need of significant changes and that in the UK, about 1.5 million jobs whereas in Turkey, 7.6 million jobs are at high risk of a partial automation. Reactions to this report vary for some scholars are in disagreement. Li *et al.* (2017) postulate that the introduction of the fourth industrial revolution in business will not only result in job losses but also in the introduction of new roles as the 4IR is accompanied by a capitalisation effect; This results in increased demand for new goods and servise which in turn leads to the creation of new jobs, businesses and even other industries.

2.7.3 Customisation of products opportunity

Evidence shows that many consumer are not interested in uniform products like before and they are increasingly switching to customised ones and businesses are now forced to deliver value to the diverse preferences of consumers (Li *et al.,* 2017). Due to this, many industries are introducing new 4IR technologies in order to give support to big data and artificail intelligence (AI) as a way to adjust their design, promotion, delivery, thereby improve customer service (Monostori, 2014).

Safar *et al.* (2018) conducted a study to examine how platforms such as Industry 4.0 will change enterprises organization and business models. They concluded that to achieve mass customisation, it is imperative to ensure that the operating network is flexible and dynamuc as the main purpose of mass customsed manufacturing process is to adapt to adapt to the requiresments of the customers. These scholars isolate the following advantages of mass customisation productions:

i. Competitive advantage and increased market share - client satisfaction and better preferences;
ii. Reduction of material waste and inventory expenses - it is a contact production, hence, it is not a necessity for the business to have a stock of finished goods;
iii. Faster and continous cash flow: faster production- reduced turnaround;
iv. Reduction of lead time which ensures flexible production and information flow allows for manufactures to quickly adapt to the requirements of customers;
v. Manufacturer's have the ability to offer a wide range of products to customers at a low costs of production - various product types with the same basic components but different final design will allow manufacturers to offer a whole range of products to satisfy every customer.

2.7.4 Reduction of costs

Bonfanti, Del Giudice, and Papa (2018) reported that employng digital tools such as a 3D digital model by artisans in Italy led to significant cost reduction in the manufacturing industry. Moeuf *et al.* (2018) substantiate that clientel relationship which is online-based has resulted in an increased level of demand for production, thus favouring the organisation of artisans. Scholars such as Chalal, Boucher, and

Henry *et al.* (2015); MacKerron *et al.* (2014) assert that a cost reduction methods are linked to improved flow synchronisation.

Advanced system of sharing information between suppliers and customers linked with real time management of flows also resulted in the reduction of stock costs (Moeuf *et al.,* 2018). Artificial Intelligence (AI) will increase business's productivity and effeciency and also result in cost reduction (Ghassan *et.al.,* 2021). A study conducted in South Africa by Bayode *et al.* (2019) mentioned that Simulation technology leads to a reduction of business costs and ensures shorter development lead times.

2.7.5 Delivery time (lead time) reduction

Scholars such as Ren *et al.* (2015) and Shamsuzzoha *et al.* (2016) postulated that using the Cloud Computing platforms reduces design time by favouring collaboration between all users of a network as well as facilitating the synchronisation of all production processes. The use of digital platforms by customers to make orders shortens the processing and execution times (Moeuf *et al.,* 2018). These views were supported by Dean & Spoehr (2018), who mentioned that digital prototyping capabilities plays a significant role in reducing the time it takes for products to start from idea to the market, better link designs to a successful product development and imporove effectiveness of engineering; these occur where open-source data sharing can have a better spin-off contribution and result in the development of new products.

2.7.6 Development of new business models

Introduction of the 4IR did not only disrupt the manufacturing industries but also brought with it new business model opportunities which respond flexiby to new markets for consumer goods, while digital production responds and puts more focus on individual customer needs (Dean & Spoehr, 2018).

2.8 Chapter summary

This chapter presented the literature from previous studies which commences from understanding the history of the fourth industrial revolution (4IR). The chapter then proceeded to the 4IR technologies applicable to small businesses, the changes and

challenges brougth about by the 4IR in the business arena. The opportunities presented by Industry 4.0 then concluded this chapter. Chapter 3 below focuses on the methodology adopted in answering the reasearch questions and objectives.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

In the previous chapter, the researcher reviewed the literature from past scholars as it relates with this study while this chapter will provide a brief description of the methodology that was used to address the research questions. Relevant details, such as - research paradigm, research design, data collection strategy and data techniques are provided, as well as the research ethical considerations adhered to. A qualitative methodology was employed in this study where data was collected using structured interview questions.

3.2 Study area

The study was conducted in different provinces in South Africa - Gauteng and Mpumalanga. In a 2016/2017 annual review of small business and cooperatives in South Africa by the DOSBD, it was concluded that the portion of SMME owners is large in Gauteng compared to the other provinces where it is sitting at 34%, followed by Kwazulu-Natal which is sitting at 18% and Mpumalanga at 8% (DOSBD, 2017).

There is a need to investigate 4IR applicable technologies, potential changes, challenges and opportunities brought about by the fourth industrial revolution (4IR) among small businesses operating in Gauteng at Ekurhuleni Local Municipality and Mpumalanga at Bushbuckridge Local Municipality. This is because Gauteng makes the highest contribution to the SMME basket and Mpumalanga is ready to launch its 4IR incubators establishment phase in Nelspruit (DOSBD, 2021). The two provinces will be represented by the following figures:

Figure 3.1: City of Ekurhuleni Metropolitan Municipality (source: municipalities.co.za)

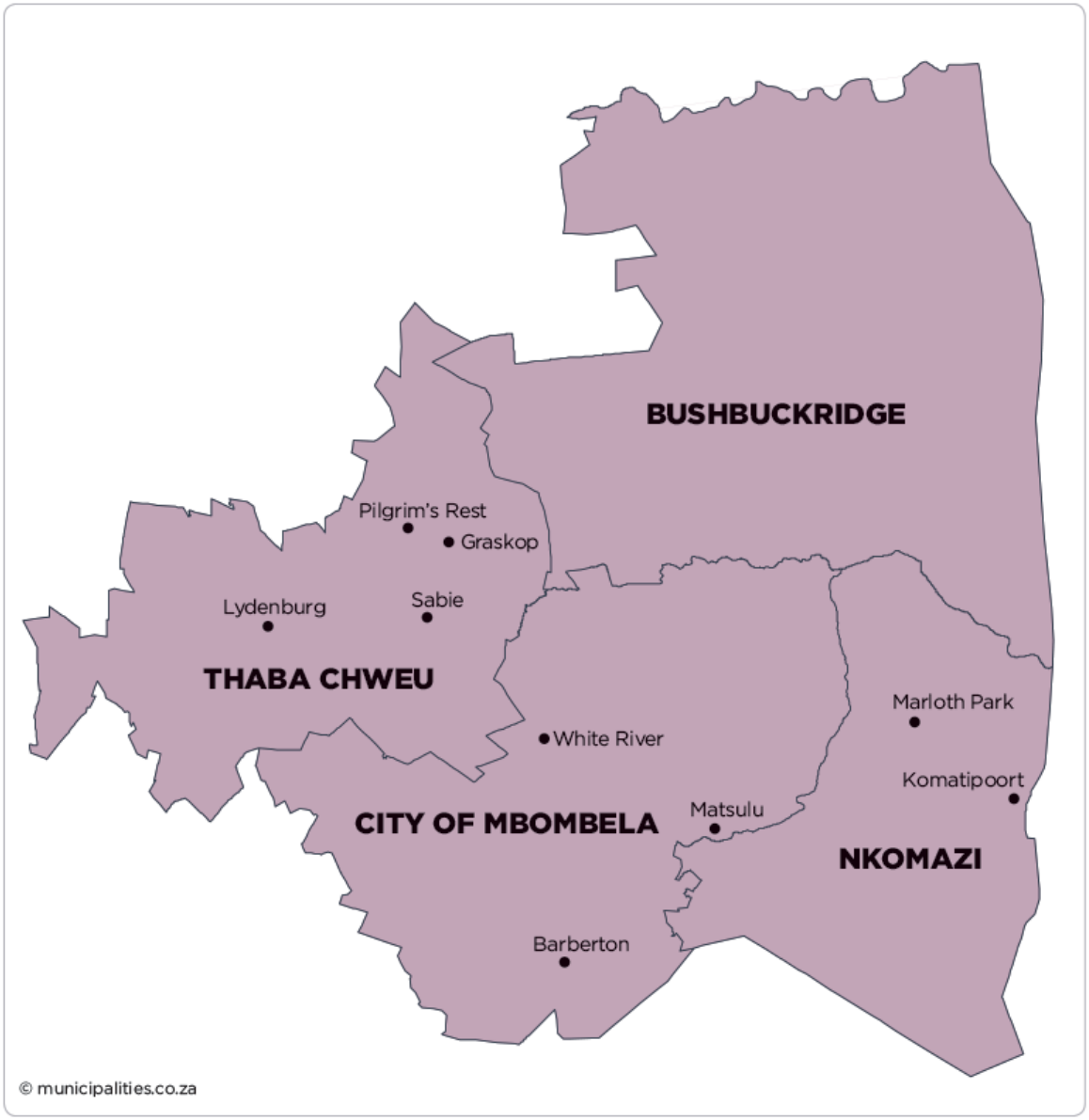


Figure 3.2: Bushbuckridge Local Municipality (source: municipalities.co.za)

3.3 Research paradigm

Research paradigms are a cluster of linked assumptions and beliefs which serve as a guide to scholars when deciding what should be studied and how the research findings should be interpreted (Kuhn (1970). It is imperative to take into consideration the research paradigm as it plays a crucial role in shaping the researcher's methodological approach employed to investigate the research questions.

Burrell, Morgan and Saunders (1979), as cited by Lewis and Thornhill (2019), identified four different research paradigms. These were Functionalist, Interpretive, Radical Humanist and Radical Structuralist:

(i) Functionalist paradigm

The scholars postulated that a Functionalist paradigm use a classical survey to address issues or solve problems.

(ii) Interpretive paradigm

This paradigm is qualitative approach-driven and employs qualitative data collection methods, such as unstructured interviews, discourse analysis and constructions of reality by “actors or stakeholders” in institutions, for example, the employers, employees and shareholders (Burrell and Morgan, 1979).

(iii) Radical humanist paradigm

Regarding radical humanist paradigm, Burrell and Morgan (1979) mentioned that it is a qualitative driven approach; however, it does not only focus on the social perceptions of participants in institutions but also seeks to probe in order to get in-depth values and social definitions which underpin an institution’s ethos.

(iv) Radical structuralist paradigm

This paradigm is historically driven; it may suggest past analysis of power in organization, by, for example, developing case studies or seeking to present transactions amongst participants in the organization, for example an employee relations analysis over time (Burrell and Morgan, 1979).

3.3.1 Justification for the radical humanist paradigm

For this study to effectively address the research problem and objectives, a Radical Humanist Paradigm was adopted since it provides the researcher with an opportunity to not only acquire social perceptions of the participants, but would also facilitate probing. This would allow an in-depth understanding of the 4IR applicable to small businesses, potential changes, challenges and opportunities brought on entrepreneurship in South Africa.

The Radical Humanist Paradigm falls within the radical change dimension, whereby focus is given to the critical perspective on organisational life (Saunders, Lewis and Thornhill, 2019). This enabled the researcher to gain different perceptions of small businesses' life.

3.4 Research Design

Lewis (2015) defined a research design as an overall outline which guides the researcher on how subjects of the study are selected and how data should be collected. Saunders and Lewis (2009) supported this definition by expressing that a research design is an overall plan on how the research will be carried out. A research design contributes to effective sample selection, collection, measurement and analysis of data.

A phenomenological research design was chosen for this study in order to investigate the 4IR applicable technologies, potential changes, challenges and opportunities brought on entrepreneurship in South Africa. Phenomenology can be explained as a way in which human beings make sense and gain insights of the world around them (Saunders and Lewis, 2009). This research design examines the unique experiences of individuals in each situation whereby focus is not merely given to 'what is' but 'what it is preconceived to be' (Koopman, 2015).

3.4.1 Justification for the phenomenological research design

Phenomenological research design is a procedure that enables the researcher to explore the lived experiences of the participants (Maxwell, 2012). This is supported by Leedy & Ormrod (2013) who argue that when using phenomenological design, the researcher can identify thematic connections ascribed by the participants regarding their experiences of the phenomenon of the study.

The focus of this study is to investigate the fourth industrial revolution (4IR) applicable technologies, potential changes, challenges and opportunities brought about the fourth industrial revolution (4IR) among small businesses operating in South Africa. A phenomenological design, therefore, helped the researcher understand the changes, challenges and opportunities experienced by entrepreneurs operating small businesses in South Africa.

3.4.2 Methodology

The terms 'methodology' and 'research methods' are used interchangeably. Methodology can be defined as the theory of how the research should be carried out (Saunders, Lewis and Thornhill, 2019). In this study, a qualitative methodology was used, which Strauss and Corbin (1990) explain as a method that relies on words rather than numbers and it can be regarded as a method used in research whereby the findings are not produced by means of quantification.

This method adopts a holistic approach which focuses on the participants' in the actual experience and it aims to contribute an in-depth understanding of the event by exploring and interpreting the collected data (Williams, 2011). Qualitative method is suitable for this study as it provides the following benefits as quoted from Mohamed, Ragab & Amr (2018):

- The collected data will be based on participants' own categories of meanings and experience.
- It affords an opportunity to study a limited number of cases in-depth and to describe complex events.
- It provides an understanding and description of participants' lived experiences of events - insiders' viewpoints.
- In-depth details of the phenomena are described as they are situated and embedded in local contexts.
- The way in which participants interpret constructs can be determined.

3.4.3 Population and Sampling

Saunders, Lewis and Thornhill (2019) the population is the set of cases from which a sample is taken. The target population of this study consists of small business-operating entrepreneurs in South Africa with special focus given to Ekurhuleni Local Municipality and Bushbuckridge Local Municipality. Sampling is the selection of a small group of cases that represents the whole population at large (Henry, 1990). It is widely employed in research due to resource constraints which makes it unfeasible to collect data from entire cases (Saunders *et al.,* 2009).

This study adopted a purposive sampling technique in order to effectively select the samples from the entire population. A purposive or judgmental sample is a non-probability sample that is chosen to effectively select, particularly, those informative individuals who will enable the researcher to achieve the research objectives (Mohamed, Ragab & Amr, 2018). When using purposive sampling, samples are selected based on the characteristics of the population and the objectives of the study (Palinkas *et al.,* 2015). The study selected a sample of 10 participants, who met the inclusion criteria mentioned below; the samples were deemed to be information-rich by this study.

The qualifying criteria for inclusion as study participants were:

(a) Small business owners
(b) Entrepreneurs operating in Gauteng and Mpumalanga
(c) Business has more than three employees
(d) Over 20 years of age
(e) Both females and males

3.4.4 Data Collection

Data collection is the systematic gathering of information to address a specific research problem (Madlala, 2017:48). Data was collected through face-to-face, in-depth interview sessions with participants while still observing the Covid-19 protocols. In cases where the researcher was unable to conduct a face-to-face interview session, other options, such as virtual interviews were employed in order to accommodate the respondent. With virtual interviews, the researcher used Zoom to conduct interviews.

The researcher obtained ethical clearance from the University of Venda Ethics Committee before collecting data and permission to interview the respondents was requested prior the actual interview session taking place. The researcher scheduled interviews with respondents in time, so as not to interrupt their daily business operations. A voice recorder was used during the interview session with the permission from the respondents in order to ensure that every response was captured.

A structured interview guide and a recording devise were used during the face-to-face and virtual interviews sessions. Scholars such as Ritchie *et al.* (2013) caution that when using a qualitative approach, there are four steps to be taken into consideration during in-depth interviews, such as - developing a sampling technique, writing an interview guide, conducting the interviews and analysing the data. The interviews were conducted in English, however, in instances where the participant needed clarity regarding the research questions, the researcher clarified using Xitsonga and Siswati which was later translated into English.

The researcher conducted a pilot study before a full-scale study was done. Denzin & Lincoln (1994: 213) recommend that in a qualitative research setting, to conduct a pilot study allows the researcher to test the research questions and to uncover areas / questions that are unclear. A structured interview guide was pre-tested during a pilot study phase where 2 small business owners were interviewed in order to ensure that the research questions are clear and they understand the questions asked. The business owners managed to answer most of the questions properly; however, the pilot study assisted the researcher to add probing questions where applicable.

3.4.5 Data analysis

Creswell (1994:155) defined data analysis as a process of methodologically searching and arranging interview transcripts, field notes and other material used to acquire in-depth understanding of a phenomenon and to allow the researchers to present what they have discovered to others. Greener (2008) postulated that with qualitative data analysis, the researcher must employ a rigorous and transparent approach as possible in order to allow the readers of such a study to understand how the findings and conclusions were drawn.

A thematic content analysis was used in this study. Thematic analysis is a systematic process of identifying themes and patterns from the acquired qualitative data (Maguire and Delahunt, 2017). The collected data from the interview sessions with the respondents was transcribed through listening to the voice records from which themes and sub-themes were drawn out. Themes, ideas and categories were then developed from the collected data; the themes were then categorised as

themes and sub-themes. In order to find meaning within the data, the researcher developed units or codes. A constant comparative mechanism was employed to identify saturation of ideas and data.

3.4.6 Trustworthiness

With the voluntary cooperation from the participants, the aim of the study is to put the knowledge produced through the research into practice; therefore, it is imperative for this research to be recognised as adhering to recognized principles, and regarded as legitimate by other scholars, policy makers, business owners and the general public. Lincoln and Guba (1985) elucidated that trustworthiness is one-way scholars can persuade themselves and their readers that their study findings are worthy of attention. In order to ensure trustworthiness, the study adopted the trustworthiness framework of Lincoln and Guba (1985) - credibility, transferability, dependability and confirmability. These elements are explored in detail hereunder.

i. Credibility

Tobin and Begley (2004) established that credibility focuses on the “fit” between the views of the cases or participants and the researcher’s representation of them. Credibility of research is determined when the readers are confronted by experience, they can recognise. The focus here is on the truth and accuracy of the research results. To ensure credibility of the research findings, the researcher employed triangulation. Merriam (1995) postulated that triangulation as the use of various research strategies with a single phenomenon to confirm the emerging results; for example, if the researcher discover an event during the interviews, observes it as it happens and reads about in relevant documents, the researcher can be confident of the reality of the event as perceived by those in it; in other words the phenomenon is being conveyed as truthfully as possible.

ii. Transferability

Noble and Smith (2015) explained that transferability focuses on the way in which a qualitative researcher highlights that the research findings are applicable to other contexts. To ensure transferability, the researcher provided a thick description of the whole research process. Lincoln and Guba (1985) maintain that it is the researcher’s

responsibility is to provide detailed descriptions to ensure that those who seek to transfer the findings to their own sites can do so, accurately.

iii. Dependability

Dependability refers to the stability of research findings over time (Anney (2014) and Bitsch (2005). To achieve dependability, researchers need to ensure that the research process is logical, traceable, and clearly documented (Tobin & Begley, 2004). Readers are able to better judge a research's dependability when they are able to examine the research process (Lincoln & Guba, 1985). One way that a study may effectively demonstrate dependability is for it to be audited (Koch, 1994). This study ensured that proper logic when conducting research was followed and relevant documentation was kept safe to afford opportunity for research auditing.

iv. Confirmability

Confirmability is more focused with establishing how the researcher interprete and findings are clearly derived from the data, requiring that the researcher indicates how conclusions and data interpretations were achieved (Tobin & Begley, 2004). For confirmability to be well established, the other elements - credibility, transferability and dependability - need to be all achieved first (Guba and Lincoln, 1989). To ensure confirmability, the researcher examined the interview processes and output to validate the data and account for all the research decisions and activities such as how the data was collected, recorded and analysed.

3.5 Limitations of the study

The following delimitations were faced during the study:

- The study was limited to small businesses and entrepreneurs operating in Ekurhuleni Municipality and Bushbuckridge Municipality excluding Medium and Large businesses.
- The structured interview guide was a limitation as respondents could only respond to the questions asked and not share more information on other different perspectives not included in the guide.

- The study areas which were Gauteng in the Ekurhuleni Municipality and Mpumalanga in Bushbuckridge Municipality were also a limitation as the study narrowed the scope of the study as other provinces and municipalities in South Africa may exhibit variable information.
- Conducting the study during Covid-19 environment was a limitation as other respondents were not feeling comfortable during the interviews even after all Covid-19 protocols were observed. This resulted in more reschedules of the interview sessions and some sessions had to be conducted virtually.

3.6 Ethical considerations

This study sought to take participants' rights into consideration when conducting this research and to ensure that the study was ethically conducted, and findings were honestly reported. To achieve these, the study followed the principles and guidelines as set by University of Venda Research Ethics Committee as clearly discussed below:

(i) Informed consent

The research purpose and nature of the participants' involvement in this study were clearly given to the participants before the data-collection process commenced. The researcher clearly outlined the parameters of the study to the participants and informed them that they could withdraw from the study at any time. Before the interview began, the researcher secured consent from each participant.

(ii) Right to privacy

It is a researchers' responsibility to ensure that participants who are protected. In order to achieve this, participants' personal information such as identity and addresses were not disclosed in this study, however, the researcher provided pseudo names, for example, participants were referred to as *Respondent 1 or Respondent 10*.

(iii) Dignity

The researcher protected and maintained the dignity of the participants and ensured that they are not subjected to any embarrassing behavior as a result of their participation in this study.

(iv) Honesty

The study reported honest findings regardless of whether the results were favorable or different from the researcher's expectations. The researcher also cited all the works of other scholars utilised in this research through a complete reference section.

3.7 Chapter summary

This chapter provided an extensive description of the research methodology in the sections under - the instruments used to collect data, research design, research paradigm, and methods employed to analyse the collected research data. The study adopted a qualitative way of conducting research because it is flexible in its application and allows for an in-depth theoretical understanding of a phenomenon. This chapter also thoroughly clarified and justified the techniques adopted in collecting the primary data, the collection process as well as ethical considerations implemented.

CHAPTER 4: DATA ANALYSIS AND RESULTS

4.1 Chapter overview

The research methodology where the procedures and processes used to answer the research questions indicated in Chapter 1 was thoroughly discussed in the previous - Chapter 3. In Chapter 2, existing studies or literature conducted by other scholars in the same discipline were reviewed in detail. This chapter presents the analysis of the data collected from the selected participants. Using thematic content analysis method, the data will be categorised into major themes and sub-themes.

4.2 Introduction

The results from the analysed data will be presented in this chapter. The aim of this study as clearly explained in Chapter 1 is to investigate the 4IR technologies applicable to small businesses, potential changes, challenges and opportunities brought about the fourth industrial revolution (4IR) on entrepreneurship in South Africa. The objectives of this study are – to identify the fourth industrial revolution (4IR) technologies that are applicable to small businesses in South Africa; to determine the potential changes that the fourth industrial revolution (4IR) can bring about in the entrepreneurial initiatives of small businesses in South Africa and also to examine the challenges and opportunities that could be presented by the fourth industrial revolution (4IR) technologies to small business' operations in South Africa.

Data was collected from 10 small business owners through the use of a structured interview guide during face-to-face and virtual sessions with entrepreneurs operating in Gauteng at the Ekurhuleni Local Municipality and Mpumalanga in the Bushbuckridge Local Municipality. The study seeks to answer the following research questions:

RQ1: What are the fourth industrial revolution technologies applicable to small businesses in South Africa?

RQ2: What are the potential changes that the fourth industrial revolution can bring about in the entrepreneurial initiatives of small businesses in South Africa?

RQ3: What challenges and opportunities could the fourth industrial revolution technologies present to small business operations in South Africa?

4.3 Participants' profiles

Data was collected from 10 entrepreneurs in two geographical areas - Gauteng in the Ekurhuleni Local Municipality and Mpumalanga in the Bushbuckridge Local Municipality. Table 4.1 below presents a summary of the participants' demographic details.

Participants	Gender	TYPE OF BUSINESS/ INDUSTRY
Respondent 1	Male	Online education platform
Respondent 2	Women	Business Management Software
Respondent 3	Women	Marketing Agency
Respondent 4	Male	Agriculture
Respondent 5	Male	AI Data Sciences
Respondent 6	Male	Marketing, Design and Print
Respondent 7	Women	General Practitioner GP
Respondent 8	Male	Fast food shop
Respondent 9	Women	Marketing promotion supplier
Respondent 10	Male	Restaurant

Source: Researcher's own construct

Please kindly note that terms 'R1- R10' stand for respondents 1 – 10,

4.4 Definition of the fourth industrial revolution (4IR)

The researcher identified common keywords after the interview sessions with the entrepreneurs which provided an opportunity to conduct an in-depth exploration of the information collected from the participants. It is imperative to explore the key patterns showing the different views from entrepreneurs who participated in this study. The study established the following keywords and statements from the collected information regarding the fourth industrial revolution (4IR):

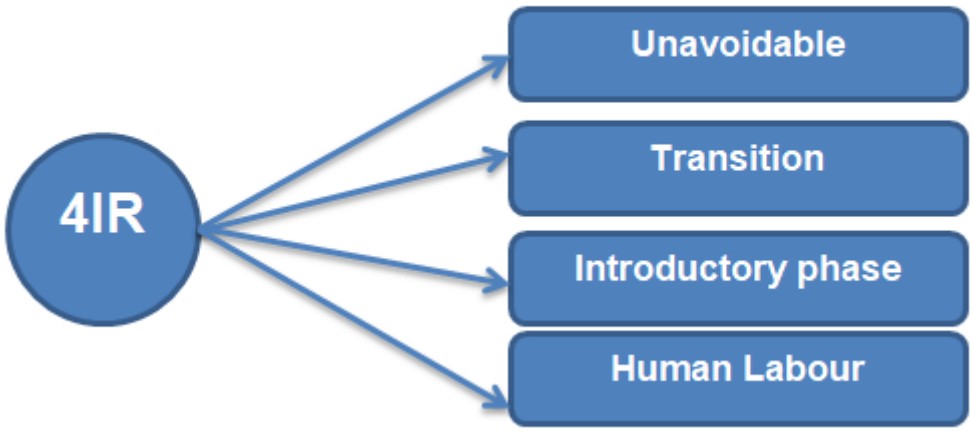


Figure 4.1 Defining the fourth industrial revolution (4IR)

Source: Researcher's own construct

After taking into consideration the different views and identifying common keyword regarding the fourth industrial revolution (4IR), the study concluded that Industry 4.0 is unavoidable (Inevitable) that it is going to happen or is already happening in the business industry and entrepreneurs have no control or cannot stop this evolution. This revolution is also a transition period (changeover) as it is a movement from an old state to a new or another state and it is an introductory phase of new or well developed technologies. Human-focused labour workforce represents manually executed work. The definition of the fourth industrial revolution (4IR) is grounded on the aforementioned keywords or statements.

The fourth industrial revolution (4IR) is defined by this study as an advanced introductory phase of new technologies which fuels the transition from human labour-based workforce to an automated-driven workforce.

4.5 The fourth industrial revolution (4IR) is unavoidable

The 4IR is seen or understood by many entrepreneurs (not all) as an inevitable wheel that is already moving. Some entrepreneurs mentioned that it is impossible to avoid the 4IR because it has already or currently is being implemented. Entrepreneurs also expressed the importance of adopting or implementing Industry 4.0 in their businesses. It is believed that those who will remain reluctant or resistant to change may cease operations or reach a shut-down point since they will be outcompeted by other businesses willing to implement new technologies brought about by the 4IR. Other benefits, such as cost saving and time saving were also mentioned to justify the need to take advantage of this business evolution. Respondent 1,2 and 5 views on this matter are indicated in the following quotations:

R1: *"No, we are in it. You cannot avoid but join. Because it is progress and advancement, and you cannot stop progress".*

R2: *"No, in my mind, I think the 4IR has already started and it is not something that businesses are going to decide upon. It is called a revolution as it is something that happens as a progression of events. Business will only decide whether they are going to adopt or perish or cease operations. The revolution itself its nothing anyone can stop".*

R5: *"No, it is very important for companies to join this revolution because if they don't step up, they run the risk not only of being left behind but also the risk of almost disappearing in the industry. Certain business functions will probably not be needed anymore and so some companies will have to adopt and some may have to change the way in which they do business".*

Following the responses from the participant, it is evident that there is an understanding of the consequences of resistance to change and also recognition for of change. Entrepreneurs made it clear that this new revolution has no room for

negotiation; - its either one adopts the technologies and new way of doing business or face the possibility of being outsmarted in the market.

4.6 Perceptions around the fourth industrial revolution (4IR) notion

The question to whether or not the 4IR is a good or a bad notion has widely been debated globally and locally, although, it remains unclear if the benefits outweigh the disadvantages since some entrepreneurs are in the implementation phase while others are resisting the change. Most of the entrepreneurs in this study were in favour of this new revolution. They believe that it has the interest of their businesses at heart, however, due to other factors, such as costs are delaying the implementation phase in their ventures. The views from respondent 6, are presented hereunder:

R6: *"I believe that in our time this is a good notion and we are fortunate to have technologies which enable us to reduce our lead or turnaround times. I am running a marketing and branding business, it is important to ensure that customers receive their orders in time, with technologies like 3D printing, the level of creativity and innovation has increased and it attracts more customers".*

Respondent 8 expressed two diverse views based on developing and developed countries. The respondent acknowledged both the good and the bad sides of the fourth industrial revolution (4IR) in the comments below:

R8: *"I think the introduction of the 4th industrial will lead to both good and bad depending on the level of development of countries. I think developed countries are the ones which will benefit more since they do not have high population growth hence their population pyramid mostly consists of old people, I believe that it will help their workforce become more productive whilst in Africa it is going to accelerate poverty and unemployment since machines and technologies are going to replace human workforce".*

The views of respondent 8 on the 4IR causing unemployment in the developing countries were supported by respondent 5 who mentioned that the introduction of

new technologies will result in redundancy of some roles in companies. The respondent shared the following views:

R5: *"The 4IR has brought a need for greater security and greater risk for financial companies and a lot of the change. A lot of jobs are being replaced by technologies as certain roles are no longer important because they are being replaced by artificial intelligence".*

Table 4.2: Fourth industrial revolution (4IR) technologies applicable to small businesses

Major Theme	Sub-theme
4IR applicable technologies	3D Printer (Printers)
	Artificial Intelligence
	Cloud Computing
	5G & Wi-Fi
	UPS
	Franking machine
	Swiping card machine
	Online invoicing technology
	Web application

4.7 The fourth industrial revolution (4IR) technologies applicable to small businesses.

This section presents the fourth industrial revolution (4IR) technologies applicable to small businesses operating in Gauteng at Ekurhuleni Local Municipality and in Mpumalanga within Bushbuckridge Local Municipality. Other technologies that are perceived to be brought about the 4IR will also be explored. Table 4.2 above presents 4IR technologies applicable to small businesses.

4.7.1 The 3D Printer

One of the 4IR technologies applicable to small businesses is the 3D printer. With this specific technology, the entrepreneurs mentioned it as one of the future desired acquisitions in the business as growth potential using this technology was recognised. This technology was also identified as having a strong impact in the promotional materials' supply business. Respondent 6 shared the following view:

R6: *"I see growth potential for my business with 3D printing; it will change the promotional material market or industry. I am planning to buy the 3D printer soon".*

4.7.2 Artificial Intelligence

Regard Artificial Intelligence (AI), the respondents mentioned that this technology is providing new business opportunity for entrepreneurs while on the other hand it poses a threat of job losses to the working class as some roles are deemed not important anymore in companies since they are being replaced by Artificial Intelligence. The following views were shared by respondent 5:

R5: *"The rise of Artificial intelligence and a lot of other technologies present new opportunities as we see new artificial intelligence businesses".*

R5: *"The 4IR has brought a need for greater security due to the greater risk for financial companies and a lot of change. A lot of jobs are being replaced by technologies as certain roles are no longer important because they are being replaced by artificial intelligence".*

Following the views of respondents 5, it is evident that a new technology such as Artificial Intelligence (AI) has both a good and bad side for different parties. The entrepreneurs did identify new opportunities to take advantage of, however, they

also mentioned that unemployment rate may increase due to humans losing their jobs as they are being replaced by AI.

4.7.3 Cloud Computing

Cloud computing is another 4IR technology that was well received and implemented by one of the respondents. This technology has come in very handy as it saves costs for small businesses. Respondent 2 shared a very in-depth explanation and also made a comparison before and after the implementation of cloud computing:

R2: *"The first one is cloud computing because it gives a business the ability to run a program and IT-related matters within the cloud. In the past when I wanted to start a company I would have to buy actual server equipment which cost thousands so many small companies that cannot afford the server equipment would struggle to just implement an email system and database because of how expensive they are and also to hire a person who can manage such systems is also expensive. Now if I start a business today I can just in five minutes use a cloud computing business like AWS or digital ocean and purchase a server and I can get my email and database going.*

Small businesses will be able to be in the markets quicker when using cloud computing technologies. They are going to benefit from that because the cost of running such a system is way cheaper. A barrier to entry for many small businesses has been shortened and now small businesses can compete with big businesses because they can build big applications in a matter of months whereas in the past the AWS and Microsoft were so big to an extent that other companies were unable to compete with them but now small businesses can actually rent severs and immediately start competing with corporates".

Respondent 6 also showed an interest in cloud computing and also mentioned the following few benefits:

R6: *"We are planning on implementing cloud computing technology to take advantage of other software within the system such as data storage to protect our business database".*

4.7.4 The 5th Generation (5G) & Wi-Fi

This study established that the 5th Generation has been identified as one of the 4IR technologies. This view is supported by an Insight, Opportunities & the Future study conducted by Shim, *et al.* (2020) in which they mentioned that the 5th Generation is being glorified as Industry 4.0. Another study conducted in Australia by Soldani and Sally (2020) concluded that the fourth industrial revolution (4IR) comprises of three most significant elements - Big data (BD), Artificial Intelligence (AI), and connected networks such as the 5th Generation. Respondent 7 mentioned that the implementation of the 5G improved connectivity in the office:

R7: *"With the new introduction to 5G I've taken advantage of the faster network connectivity and installed a new office router. Now my staff can process insurance and medical claims faster. They can also communicate with customers and other stakeholders easier. The in-house pharmacist is also in love with the faster network when he dispenses the prescriptions".*

4.7.5 Other Technologies

Some entrepreneurs mentioned other technologies such as UPS, invoicing technologies, swiping card machine and Web application as technologies brought about by the 4IR. While the 4IR may be playing a significant role in improving the performability of these technologies, it is clear, however, that these technologies existed before the introduction of this new revolution.

Table 4.3: The Potential changes presented by the fourth industrial revolution (4IR).

Major Theme	Sub-theme
Potential Changes	Technological change
	Structural change
	Business model change
	Productivity change
	Profitability and Income change
	Barriers to market entry change
	Strategic change

4.8 The potential changes presented by the fourth industrial revolution (4IR) in the entrepreneurial initiatives of small businesses.

It is evident that the introduction of new advanced technologies brought about by the 4IR will bring with it changes in the entrepreneurial arena. These changes may present opportunities and also challenges. This section will thoroughly discuss changes presented by the 4IR.

4.8.1 Technological and Structural change

Industry 4.0 is a technology-driven revolution which presents new opportunities, challenges, changes and also improves the way in which business is conducted. Entrepreneurs highlighted that the use of 4IR has changed business operation; the movement from human workforce to advanced technology has introduced smart ways of working and this saves time. The following extract presents an explanation by Respondents 2 and 4:

R2: *"These technologies are going to change the way in which businesses operate whereby we are to move from an industry led by manual labour to an industry that is going to be led mostly by technology, such as internet, connected technologies and machines".*

R4: *"Previously we were relying on human labour, but with the introduction of the 4IR, machineries (the motor) seemed to have replaced the human labour. The human-intensive labour was huge because you needed to work hard but now with these new technology we work smart and they save us time. For example, when digging a hole with human labour it takes more time compared to when you are using technology".*

Following the above responses from the participants, it is evident that businesses are going through a restructuring process due to the introduction of well-advanced 4IR technologies. They are moving from human workforce to automation, however, human intervention will still be required and will not be phased out completely.

4.8.2 Business model change

In respect of business models, 4IR has given small business an opportunity to operate online. Some businesses have moved from physical-field operations to 100% online based. The business model change experience by small businesses is evidenced by the following quotations:

R1: *"We used to go to schools and universities and we are no longer doing that anymore but shifted to online so that a big proponent and capability that the 4IR has given us, is the ability to create the same level of efficiency through the digital form".*

R7: *"I see that healthcare has now moved to digital, I see now that doctors and nurses are moving to virtual consultations, and I would also like to move into that market. I already have Wi-Fi and a computer in the office, I just need to advertise the new venture digitally, of course".*

4.8.3 Barriers to market entry change

Small businesses have always found it challenging to compete with reputable and established businesses, however, with the introduction of 4IR technologies, many of the barrier to entry has been lowered and small business are now able to compete with large corporates. The cost of starting a business was, previously also high as compared to now. The following quotations establish the views of the respondents regarding some of the barriers to market entry:

R2: *"Now if I start a business today I can, just in five minutes use a cloud computing business like AWS or digital ocean and purchase a server and I can get my email and database going. Small businesses will be able to be in the markets quicker when using cloud computing technologies. They are going to benefit from that because the cost of running such a system is way cheaper. A barrier to entry for many small businesses has been shortened and now small businesses can compete with big businesses because they can build big applications in a matter of months whereas in the past the AWS and Microsoft were so big that other companies were unable to compete with them but now small businesses can actually rent servers and immediately start competing with corporates".*

R1: *"The processes of starting a business are a lot faster; before I had to go and find or write a business plan and submit to the bank for funding, sign lease agreement*

with a shopping mall, buying of business furniture. The industry has changed now, I can start my business tomorrow without talking to anybody or apply for business funding due to technology".

4.8.4 Productivity change

The introduction of new and advanced 4IR technologies will lead to a change in the way in which products are manufactured and services are rendered. This change will ultimately cause the productivity levels to either increase or decrease. While productivity may increase due to automation, it also true that it may also decrease due to employee lack of skills and knowledge to implement these new technologies. Implementing these new technologies requires businesses to create a conducive environment and failure to do so may hinder productivity. Participant 6 is of the view that 4IR technologies will lead to the correction of production shortfalls and increase productivity. The views of the respondent are indicated in the following excerpts:

R6: *"Mass production and productivity level increase- We have increased the levels of production since we are no longer relying on manually branding some of our products we have advanced embroidery machines and printing machines that allows computer configurations to effectively produce more within a few minutes. When we started branding mugs for our customers we were only using one mug press which you can brand one mug in 4 minutes but now we have mass production mug press which allows us to brand five mugs in just 4 minutes".*

4.8.5 Profitability and Income change

The respondents in this study highlighted that the 4IR technologies will increase profitability and income earned by businesses. One of the respondents mentioned that adopting the artificial writer software which assists with content marketing, may help with minimising cost of hiring and in so doing, increases the level of profit. The views of respondent 2 are expressed hereunder:

R2: *"One of the big trends that are in the content marketing space now, is that people are no longer hiring writers now for content marketing but they are installing artificial writer software that will just write for you so if you can have a technology that you can use to produce all your content, why would you hire another person to do*

that for you manually, whereas technology can do it better? So, companies are finding it as a great cost-minimising mechanism causing increase in profitability".

4.8.6 Strategic change

The fourth industrial revolution (4IR) has had an impact on business strategy and the way in which businesses do things. Changes will have to be made in order to accommodate these new technologies. In preparation for the implementation of the 4IR, respondent 9 expressed the following views:

R9: *"A comprehensive 4IR strategy will help businesses navigate the new digital era, regardless of whether they are just beginning to plan or have already adopted new technologies. By implementing technology for both production and oversight, investing in both humans and machines, and letting business needs drive their strategy, businesses will be well-equipped for the new digital era".*

4.9 Opportunities brought about by the fourth industrial revolution (4IR)

The introduction of the fourth industrial revolution (4IR) technologies is presenting new opportunities for existing and potential entrepreneurs. This section discusses these opportunities.

Table 4.4: Opportunities brought about by the fourth industrial revolution (4IR)

Major Theme	Sub-theme
4IR Opportunities	Time saving Cost saving Increased productivity Job creation Narrow location gap Paperless operation New income stream and business Increased accessibility Increased Digital Marketing demand Online invoicing technology Improve Marketing & Sales Campaigns

4.9.1 Time saving

The time factor was well emphasised in the interview sessions with the respondents. Entrepreneurs need to respect time and ensure that lead time is reduced without sacrificing the value of their offerings - products and services. Entrepreneurs are of view that the fourth industrial revolution (4IR) has presented them with the opportunity to reduce lead time which starts when an order by the customer is made till the date in which the product is delivered or service is rendered. The views of the respondents are indicated in the following excerpt:

R4: *"Time is a serious factor in business so obviously we want to produce more within a very short space of time so for you to minimise or achieve more within a short space of time, you need to move from a conventional way of doing things to the technological way. In short, you get the work to be done fast because what would ordinary be done in a period of five years, you can achieve it in 6 months".*

These sentiments are echoed by respondent 6.

R6: *"Automated business operation has enabled our business to reduce productions and delivery times".*

4.9.2 Cost saving

Businesses are constantly strategizing on ways in which cost can be saved in different operations, while remaining efficient. The respondents expressed the importance of saving time in different activities with their businesses and a recognition of how these new technologies brought about the 4IR are helping in cost-saving or reduction of expenses. Some entrepreneurs mentioned that the use of these 4IR technologies reduces head counts or human workforce which results in salary expense reduction. The entrepreneurs indicated that:

R4: *"Cost saving due to number of human labour being minimised".*

R6: *"We have few employees who operate the machines for production and others are placed in digital marketing to raise digital awareness of our offerings. As previously mentioned, we won't be hiring an accountant or bookkeepers since we are using software to execute accounting activities online. After configuring our*

machines for production, we have noticed that the level of production mistakes have massively decreased, which saves production expenses".

The above quoted entrepreneurs had their focus on human workforce expense reduction. Fourth industrial revolution (4IR) technologies allowed them to operate at full capacity with few employees, thus, reduce salary expense. Respondent 3 focused on other forms of expenses.

R3: *"Meeting virtually saves time and other expenses such as petrol cost since we can have our meetings via Zoom. Animation technology also because instead of having big production, clients are choosing animation for marketing since it saves them money compared to the normal marketing video production".*

4.9.3 Increased productivity level

From the information provided by the respondents, the introduction of the 4IR new technologies has enabled their businesses to increase the level at which products are produced. One promotional material-printing respondent mentioned that the business is now able to take advantage of mass production opportunity. Another respondent mentioned that the business can provide quick response to customers' enquiries. This rationale is shown in the following extracts:

R1: *"Quick response capabilities because things are automated".*

R6: *"Mass production and productivity level increase. We have increased the levels of production since we are no longer relying on manually branding some of our products we have advanced embroidery machines and printing machines that allows computer configurations to effectively produce more within a few minutes. When we started branding mugs for our customers, we were only using one mug press which can brand one mug in 4 minutes but now we have mass production mug press which allows us to brand five mugs in just 4 minutes".*

4.9.4 Job creation

The fourth industrial revolution (4IR) technologies have been perceived as the era that will phase out human workforce. Entrepreneurs shared different views about such beliefs. It is evident that some roles will be phased out due to the introduction of new technologies; however, the other side that has been overlooked, is that some

4IR technologies are presenting new roles, such as a workforce that will maintain and code or program these new technologies. Businesses that have already implemented the new technologies have created employment opportunities which benefit the general public due to the required skills. These were sentiments from Respondent 2:

R2: *"AI is seen as a technology that will take people's jobs however it also creates jobs because there is someone who will be hired to code the AI system and new opportunities will be created".*

Respondent 5 maintains the belief that technology, such as artificial intelligence (AI) to be the one that will phase out human workforce roles.

R5: *"A lot of jobs are being replaced by technologies as certain roles are no longer important because they are being replaced by artificial intelligence".*

4.9.5 Narrow location gap and increased accessibility

Industry 4.0 has presented an opportunity for entrepreneurs to conduct business and meet with customers virtually without having to physically meet. Businesses and customers have gained more access to each other than before. Clients, for instance, now prefer to book online consultations with their doctors, due to the past pandemic. The respondents shared the below views:

R3: *"These technologies help narrow the location gap because I am able to conduct business online without having to drive and physically meet clients".*

R7: *"The customer base is now broader. I mean with this past COVID19 pandemic, people are not willing to go out so seeing a doctor in the comfort of your own home is amazing".*

Respondent 1 shared that they changed their business model and now they are 100% operating online and still managing to deliver the same level of value. These technologies, thus, have made it easy to access customers online.

R1: *"So we are currently a 100% online business, so we have digitised our offering. We used to go to schools and universities and we are no longer doing that anymore but shifted to online so that a big proponent and capability that the 4IR has given us is the ability to create the same level of efficiency through the digital form. More*

importantly, it has also presented the opportunity to access any CEO through LinkedIn or other social media platforms; the degree of separation, in terms of access, is greatly reduced".

4.9.6 New income stream and new businesses

From the interviews, entrepreneurs mentioned that the fourth industrial revolution technologies have presented opportunities for new businesses and new income streams. A respondent mentioned that the process of starting a business is easier now with the use of new technologies. Entrepreneurs who have already taken advantage of the new technologies mentioned the following benefits:

R7: *"I see that healthcare has now moved to digital, I see now that doctors and nurses are moving to virtual consultations, and I would also like to move into that market. I already have Wi-Fi and a computer in the office. I just need to advertise the new venture digitally, of course. This opportunity will be bringing a whole new income stream, the customer-base will be broad. I mean with this COVID19 pandemic, like me, people are not willing to go out so seeing a doctor in the comfort of your own home is amazing".*

R1: *"The processes of starting a business are a lot faster, before I need to go and find or write a business plan and submit to the bank for funding, sign a lease agreement with a shopping mall, buy business furniture. The industry has changed; now I can start my business tomorrow without talking to anybody or applying for business funding due to technology".*

R5: *"Another feature is the rise of Artificial Intelligence, so a lot of technologies which presented new opportunities as we see new artificial intelligence businesses".*

4.9.7 Improve Marketing & Sales Campaigns

Another benefit of Industry 4.0 technologies, such as Artificial Intelligence, is the ability to improve sales and marketing campaigns. Improving sales is an important strategy for businesses. One respondent indicated that:

R5: *"I am planning to implement Artificial Intelligence technology for market research and I'm hoping it will tailor and understand the market and by doing that, it will improve marketing campaign and sales campaigns".*

4.9.8 Increased Digital Marketing demands

Some of the interviewed respondents indicated that there is an increased demand for digital marketing. Businesses were going in that direction, however, the process has been expedited by the Covid-19 pandemic which forced businesses to change their strategies from traditional to digital marketing. With the use of digital marketing, Respondents mentioned, in the following extracts, that there is an increase in the level of awareness of business offerings. Such evidence is indicated in the following extracts:

R3: *"Digital marketing, we were moving in that direction already but with Covid 19 we were forced to move quicker than we were anticipating, and digital marketing has become quite a big portion of what clients want to spend money on and there is more opportunity as far as our industry is concerned".*

R6: *"Increased level of awareness with the rise in digitising business operations. We are doing more of digital marketing to raise the level of our offerings. Social media works wonders for our business".*

In the light of the above evidence, digital marketing strategy has been existing way before the fourth industrial revolution (4IR) came into the picture, however, there are some new technologies brought about the 4IR that improved the digital business arena. Artificial Intelligence (AI), Augmented Reality (AR), 5th Generation and Internet of Things (IoT) play an important role in digital marketing.

4.9.9 Paperless operation

Another benefit that was appreciated by one of the entrepreneurs is the paperless system's way of working which came about from digitising most of the business operation. This did not only change the way in which businesses were conducted but also functioned as an expense-reduction mechanism as owners do not have to hire anyone to handle paperwork. The below views are shared by Respondent 1:

R1: *"We are juggling between the capabilities of automating certain things so we are utilising technologies that make us more paperless which result in minimising the number of people that we should hire".*

Table 4.5: Challenges brought about by the fourth industrial revolution (4IR)

Major Theme	Sub-theme
4IR applicable technologies	Cost of production loss Adaption and adoption Recognising the need to change Uncertainty Lack of knowledge/ Misunderstanding/ Misinformation Insufficient Infrastructure High cost of capital and maintenance Lack of free 4IR-based business incubation initiatives Hacking and Cyber Crime challenges Power or Electricity cuts Lack of operating skills

4.10 Challenges brought about by the fourth industrial revolution (4IR)

This section consists of challenges faced by entrepreneurs as a result of the fourth industrial revolution (4IR). It is evident that the 4IR is not only presenting opportunities but also challenges in the entrepreneurial arena; this was highlighted by the literature review in Chapter 2 and this study's data analysis. The challenges are discussed thoroughly hereunder:

4.10.1 Cost of production loss

The study has established that there are pros and cons of implementing the fourth industrial revolution (4IR) technologies. Some respondents mentioned that these new technologies will lead to a rise in productivity, Respondent 4, however identified some productivity challenges associated with the 4IR. Automated system, for example, will suffer as a result of power cuts currently happening in South Africa. Respondent 4 shared the following views:

R4: *"Loss of cost of production due to power cuts or load-shedding and fuel price increase"*.

Following from the above views, it is evident that even though the power-cuts issue is becoming a norm in South Africa, this has led to more cost for the business as the price of fuel is continuously increasing.

4.10.2 Adaption and adoption

Respondent 1 raised an important view about adapting and adopting of these new 4IR technologies for business. Entrepreneurs need not only adapt the 4IR technologies but also, they should find ways in which they can adopt them in their business setting. It is challenging to implement the 4IR technologies due to these two concepts. Respondent 2 explained the following:

R1: *"Adaption and Adoption of new technologies - We find it difficult to adapt to the new technologies and after that stage another issue is to adopt and implement these technologies within the construct of the business".*

4.10.3 Recognising the need to change

Some respondents in this study expressed the urgency to change or the desire to implement new technologies brought about the 4IR in their business, as one of the challenges. It is important for entrepreneurs to continuously do research on strategies and be innovative in order to avoided products or service absolution. Respondent 9 shared the views below:

R1: *"Recognising the need to change, recognising the aspects of the technology that it brings and you now having to give up your CDs and now being able to stream music from Apple and having to give".*

4.10.4 Uncertainty

It is evident throughout the study that introducing the new 4IR technologies has its pros and cons. Some entrepreneurs face financial challenges to gear their businesses with advanced technologies, however, Respondent 1 mentioned a different challenge, uncertainty, as these new technologies are not only showing promising opportunities to businesses but they also bring with them new threats. The following extract presents an explanation by Respondent 1:

R1: *"Uncertainty- How do you adopt or implement these new technologies but also have the foresight not to do something today that would negatively impact your life tomorrow?".*

4.10.5 Lack of knowledge/ Misunderstanding/ Misinformation

The 4IR has become a major debate in the academic and business world, however, a lot of people understand it differently. Sources which are unverified, different and with different views are used and this may lead to misunderstanding and misinformation. Lack of understanding, misunderstanding and misinformation may hinder the implementation of these advanced technologies as some people may focus on what they believe to be the negative part of these new technologies. The views of the respondent are indicated in the following excerpts:

R2: *"Lack of knowledge and misunderstanding or misinformation - For examples, if we look at block chain, a lot of people don't understand what it is and then because of lack of understanding other people come and try to explain it in certain ways which*

result in other small business owners resisting it since it appears to be something bad. Some business owners do not take time to understand but listen to what others are saying. Block chain is one of the highly misunderstood technologies although AI is also a misunderstood because a lot of people understand it to be a technology that has come to take their jobs".

From the views of the above respondent, it is evident that lack of knowledge, misunderstanding and misinformation can encourage resistance to the implementation of new and advanced technologies. Informed and sound decisions leading to successful implementation cannot be achieved with wrong information.

4.10.6 Insufficient Infrastructure

For change to be made successfully in a business, it is important that the infrastructure support the new changes. It is imperative for business owners to ensure that the environment and infrastructure are conducive before implementing the new 4IR technologies in their businesses. Insufficient infrastructure may result in implementation failure which may in turn rather increase expenses and reduce production. The view of respondent 10 is shared below:

R10: *"Insufficient Infrastructure which may cause production delay"*.

4.10.7 High cost of capital and maintenance

Another challenge hindering the implementation of Industry 4.0 technologies is lack of finance and the high cost of maintaining them. Small businesses may find it difficult to implement innovations and be competitive in the market due to the cost. Automated machinery in manufacturing comes at an expensive price and this poses a challenge of acquisition for small businesses. Explanations from Respondents 8 and 6 are shown in the following statement:

R8: *"It is very difficult to keep up with these technologies because they are difficult to maintain and many are expensive to acquire. My business is still small, hence, it requires long term budgeting to purchase latest and complex technologies".*

R6: *"High cost of capital required - buying of machinery was the most challenging thing for our business as it required lots of capital. We tried to apply funding with no*

luck and all we had to do was personally budgeting and finance the business. Advanced machinery comes at a cost".

4.10.8 Lack of free 4IR-based businesses' incubation initiatives

Business incubation with special focus on the fourth industrial revolution (4IR) is critical to the successful implementation of these advanced technologies. Small business owners and their employees need to be trained on how to use 4IR technologies in order to fuel the implementation and allow for efficient production of goods and services. Initiatives may be implemented but with lack of knowledge and sufficient skills, it will not be a success. The following views were shared by Respondent 6:

R6: *"Lack of free 4IR business incubation programs - The 4IR has been a topic for some time now in news, social media platforms and other television channels. The benefits and disadvantages are well discussed or debated. We have looked for free incubation support around Mpumalanga that is focusing on this new revolution and did not found one at the moment. It is really challenging to implement with little or no theoretical knowledge of the 4IR".*

4.10.9 Hacking and Cyber Crime challenges

Cyber-crime, such as hacking is one major challenge for most of the 4IR technologies. Hacking is not a new concept in the business world as businesses have been constantly trying to find ways in which they can protect themselves against hackers by employing strong and continuously upgrading firewalls. These crimes are committed for various reasons, such as stealing or destroying company data and other resources. The experience of such crimes was shared by Respondent R6 below:

R6: *"Hacking challenges - We have been hacked one time, one of our employees clicked some links via email. The hackers posed as customers, they send an email looking for a specific promotional item which we could only see by clicking the link. Fortunate enough none of the business money was stolen but we suspect that maybe they only accessed business information".*

4.10.10 Power or Electricity cuts

Most small businesses rely on electricity for operation or execution of business activities; some are able to operate for some hours after power cuts but those involved in manufacturing are forced to cease operations. In South Africa, electricity power cuts have become a major issue faced by small business. Choosing alternatives such as solar panels and generators are expensive options as there is also a hike in the price of fuel in the country. Such challenges lead to a dramatic decrease in the level of production. The views of Respondent 4 are indicated in the following excerpt:

R4: *"Loss of cost of production due to power cuts or load-shedding and fuel price increase"*.

4.10.11 Data and Privacy risk

One of the respondents mentioned that another challenge brought about by the introduction of Industry 4.0 technologies is concerned with data privacy risk. In situations involving hacking, consumers may now become skeptical and selective in their information that they previously shared with businesses. This challenge build from the one discussed above in section 4.10.9, that data can be accessed by hackers for different reasons. A question as to whether small business can put all measures necessary in place to protect consumer data remains unanswered. Such was indicated in the following excerpt:

R9: *"As technology continues to advance, there are growing concerns over data privacy and ownership. The proliferation of 4IR advanced technologies such as Internet of Things, 3D printing, and genetic editing build on advances in digital and AI capabilities. These technologies present both risks and opportunities related to data protection and privacy issues".*

4.10.12 Lack of operating skills

The know-how with regard to operating the 4IR advanced technologies plays a very crucial role in ensuring successful implementation. It is evident from the ones who have implemented these new technologies in their businesses that there is a level of challenge due to lack of operating skills; such a challenge may reduce the level of production and consequently affect its quality. Another respondent mentioned the

same challenge by expressing that these new technologies bring with it a gap in technical skills and this calls for the skills of current workforce to be upgraded. The explanations from Respondents 6, 9 and 10 are shown in the following statements:

R6: *"Lack of machine operating skills - We struggled to operate the machines in the first few months of operation, however, YouTube came in handy for our business. We learned everything we know now online and we have improved with time".*

R10: *""The challenge faced by my business is up-skilling employees, older generation adapting to the technology and the resources of the actual technology".*

Following the views of the respondents, another element which may hinder the process of implementation of 4IR technologies is age. The older generation workforce may find it difficult or may take time to adapt to the advanced technologies. This may result in employees' resistance to adopting these new technologies in the business.

4.11 Chapter summary

The findings from small business owner's interviews were thoroughly discussed in this chapter. The use of a Phenomenological research design to obtain lived experiences of the respondents as well as a qualitative research approach was beneficial in gathering all relevant data from the respondents. Thematic content analysis tool was also helpful in developing relevant themes that managed to address the objectives of the study. The collected qualitative data allow for the interpretation and presentation of research findings which will be in Chapter 5.

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Chapter overview

The previous chapters provided a justification for this study, review of literature, details on the research methodology, and analysis of data. This chapter builds upon the analysed data presented in Chapter 4 as the results of the study will now be thoroughly discussed.

5.2 Introduction

In Chapter 1, it was indicated that the purposes of the study is - (a) to identify the fourth industrial revolution (4IR) technologies that are applicable to small businesses in South Africa; (b) to determine the potential changes as a result of the digital transformation and (c) to determine the challenges and opportunities brought about by the 4IR on the entrepreneurial initiatives of the small businesses in South Africa.

There is an on-going debate on the fourth industrial revolution (4IR) concept; the notion has not been fully addressed in the body of knowledge, for instance its contribution to entrepreneurship. Its contribution to small businesses operating in South Africa has not yet sufficiently been addressed in academic literature. This study, therefore aimed at contributing to a deeper understanding of the applicable 4IR technologies, potential change, challenges and opportunities presented by 4IR to small businesses.

This chapter comprises of different sections mainly discussing the findings of this study while considering the views and opinions of past studies conducted by other scholars in South Africa and also at the international level. It should be noted that the findings of this study, along with the research objectives, may support, contradict and add on other academic works indicated in Chapter 2.

5.3 Discussion of results

The findings of this study in relation to those of the past scholars are thoroughly discussed in this section.

5.3.1 The fourth industrial revolution (4IR) definition

Through this study, the researcher has established that there is no universal definition of the fourth industrial revolution (4IR), however, there are common elements that bring the 4IR into existence. Scholars around the globe define the fourth industrial revolution (4IR) from different perspective, for example, manufacturing based industries looks at the 4IR from a different perspective to those in e-commerce sector.

Scholars such as Kagermann *et al.* (2013) and Kang *et al.* (2016) gave a production-perspective definition of the fourth industrial revolution (4IR) stating it as a revolution that is based on the development of Smart Factory (SF). Ghosh, Chakraborty & Law (2018) gave an industry-neutral definition; they defined the 4IR as a collective of various technologies that narrow the gap between the digital and physical world and it is further considered a mixture of significant computations - Artificial Intelligence (AI), Internet of things (IoT) and many other advanced new technologies.

Similar definition is expressed by Pató *et al*. (2020); they see the 4IR as an event comprising of information technology and automation that are increasingly intertwined with the physical world and thus, it is a combination of virtual and real physical world. The findings of this study concur with these different definitions, however, this study further established other important elements that accompany the 4IR- unavoidable, transition, introductory phase and human labour. This study acknowledges the fourth industrial revolution (4IR) as an advanced introductory phase of new technologies which fuel the transition from human labour-based workforce to an automated-driven workforce.

5.3.2 Unavoidable fourth industrial revolution (4IR)

Following this line of thought, the findings for this study argue that the fourth industrial revolution (4IR) is an inevitable event that is already in motion. Entrepreneurs have no choice but to adapt these new 4IR technologies if they want to remain competitive in the market. They do not have to implement all of these technologies due to challenges, such as not being able to create a conducive environment for implementation or lack of adequate infrastructure and other

challenges. Little, however, has been said about whether this new revolution can be avoided.

5.4 Fourth industrial revolution (4IR) technologies applicable to small businesses

In the light of the fourth industrial revolution (4IR) technologies applicable to small businesses, the study has established the following technologies:

5.4.1 The 3D Printer

The findings identified 3D printing as one of the fourth industrial revolution (4IR) technologies that is applicable to small businesses. Sutherland (2020) and Zhang *et al.* (2021) listed 3D printing as one of the technologies brought about by the 4IR. The study of Abeliansky *et al.* (2020) highlighted 3D printing as one of the technologies that will replace human workforce, however, the applicability of this technology in small businesses' setting has been left unexplored. This study also established 3D printing as a technology that will make a significant contribution to promotional materials' business.

5.4.2 Artificial Intelligence

Martinelli, Mina & Moggi (2021) mentioned that Artificial Intelligence is employed in assessing complex patterns of data and process information in order to make an informed decision. Oke & Fernandes (2020) explain that AI is used when businesses analyse existing data to initiate new and creative product launches and also to transform their business model. The findings of this study supports the points of Oke & Fernandes (2020), however, highlighted the two sides of Artificial Intelligence - this new technology has brought about the introduction of new business opportunities but on the other hand, could leave some employees jobless.

5.4.3 Cloud Computing

This study also argues that Cloud Computing is another fourth industrial revolution (4IR) technology that is applicable to the small businesses' setting and implementation has already taken place with many businesses. This technology has successfully reduced business expenditure. These findings substantiate those of

Amaral and Peças (2021), who confirmed that implementing this technology has assisted small businesses to overcome some of their main challenges. These include - closing the gap on day-to-day operations without major problems and issues, such as missed deliveries or failure to complete an order and reducing unnecessary expenses incurred when the aforementioned problems occur. This study also established that other benefits relate to the level of storage and data protection presented by cloud computing. Similar findings were obtained from a study conducted by Beáta *et al.* (2020), who found that cloud computing has a significant impact on managing large amounts of data - its storage and protection.

5.4.4 The 5th Generation (5G) & Wi-Fi

Schwab (2016) and Penprase (2018) mentioned 5G network as one of the technologies brought about by the 4IR. Chavhan (2022) found that 5G connectivity has a significant impact in the reduction of delays in the processing of computer data over network connection. Alsenwi *et al.* (2021) mentioned that 5G paved the way to incredible holistic capabilities such as 3D entertainment and massive IoT connectivity. This study concurs with the findings of the aforementioned scholars as they reveal 5G network to be part of the technologies employed by small businesses to take advantage of faster connectivity and communication.

5.4.5 Other Technologies

While the debate on the fourth industrial revolution (4IR) continues, the study has established that there is still a gap regarding the technologies applicable to small businesses. Entrepreneurs still need to be more knowledge as they mistake pre-existing technologies to be brought about by the 4IR. The technologies mentioned during the interviews were UPS, invoicing technologies, swiping card machine and Web application as technologies brought by 4IR.

5.5 The Potential changes presented by the fourth industrial revolution (4IR).

The introduction of 4IR has brought changes in the entrepreneurial arena and general lives of businesses and their employees. These changes cover both the negative and positive aspects of change in general. The study has established the following changes which will be discussed in depth hereunder:

5.5.1 Technological and Structural change

The findings of the study revealed that the fourth industrial revolution (4IR) technologies have brought about changes in business operation and its structure caused by the shift from more reliance on human workforce to automation. This change has also resulted in saving of time. These findings support those of Pató *et al.* (2022), who maintain that the transformation brought about by the fourth industrial revolution (4IR) has changed the way work is carried out and the work that requires intense human effort will now be performed by robots. This will result in an increase of operational efficiency and even the level of sustainability.

Findings of this study also support those of Kagermann *et al.* (2013) who revealed that 4IR technological development will result in change of the work structure as the range of repetitive tasks is narrowing while the number of complex skills tasks is increasing. It is important to note that these advanced technologies will not completely phase out human labour but the two strategies will work collaboratively. Becker & Stern (2016) mentioned that automation is not only important in ensuring a smooth operation of simple and repetitive activities and eliminating human errors, but human intervention will still be needed.

5.5.2 Business model change

With regard to business model change, the study found that the fourth industrial revolution (4IR) has presented a change of operation from businesses being physical-based to online-based. This view concurs with the findings of Xing & Marwala (2017), who found that the introduction of 4IR technologies has transformed the education sector; businesses are now providing massive online courses. In addition, the study established that it's not only small business in the education sector that has experienced this change, but general medical practitioners have also adopted the online way of conducting business.

5.5.3 Barriers to market entry change and emerging businesses

The findings reveal that some of the barriers to entry have been shortened or removed as a result of the 4IR technologies; for example, the emerging online businesses and the ability of starting a business online. Small businesses are now also able to infiltrate markets which they previously were unable to and also to

manage to compete with large corporates. Similar findings were obtained from a study conducted by Bordas (2022), who concludes that Artificial intelligence (AI) has introduced a huge positive change, however, such a technology of this magnitude will require start-ups for small, medium and large companies.

5.5.4 Productivity change

An investigative study which focused on investigating the effect of digital technology on productivity for 32 developed countries was conducted by Venturini (2019). The study revealed that advanced technologies have a positive effect on productivity and growth. Another study which focused on developing countries which were concentrating on China and those in Latin America was conducted by Tchamekwen (2019). The researcher examined the impact of digital technologies - Artificial Intelligence (AI), Cloud Computing, Internet of Things (IoT) and Big data. The results established that all digital technologies have a positive contribution on productivity and growth.

The findings of this study concur with those of the aforementioned scholars as they established that the introduction of the 4IR technologies will result in a change in the manufacturing process and also the way in which service is rendered which in turn will lead to an increase in productivity levels. The study, however, also looked into the negative side of these advanced technologies. The results showed that lack of adequate skills by employees to operate these advanced technologies may also lead to a reduction of the levels of production for a short while until highly-skilled personnel is sourced; another element is conducive environment or infrastructure to implement the technologies. The implementation may hinder productivity if these two elements are not put in place.

5.5.5 Profitability and Income change

Following this line of thought, the findings for this study revealed that the fourth industrial revolution (4IR) technologies help reduce operating expenses and also increase the profitability of the business. The 21st CEO survey conducted by PwC (2018) is in line with the findings of this study, it revealed that predictions show that immense productivity gains and profit will benefit the overall economy, however, it will come at a great cost to those who are unable to rise to challenges in time.

Findings of this study also support those of Soh and Connolly (2021), who found that the fourth industrial revolution's technologies are glorified by the private sector due to their capability in ensuring profitable recordings.

5.5.6 Strategic change

With the new advanced 4IR technologies, businesses that have implemented or are still going to implement will experience a change is strategy or the way in which they conduct their businesses. The change will be put in place in order to accommodate the new technologies. Ustundag (2018) support these findings, although the author focused on the human resource aspect. This study admitted that in this era of the 4IR there will be gaps in skills, and businesses should not only implement strategies of acquiring new talent but also retain current employees and redesign work processes. Similar results on human resource-related strategy was obtained from a study conducted by Kaasinen *et al.* (2020) where the scholars mentioned that as technology keeps on evolving and more working environments becoming sensitive to automation, new software and tech-conferences on these advanced technologies are emerging.

5.6 Opportunities brought about by the fourth industrial revolution (4IR)

The opportunities presented by the fourth industrial revolution (4IR) to small businesses and entrepreneurship in South Africa are presented in this section.

5.6.1 Time saving

The study revealed that time is a significant factor in business and it is essential for entrepreneurs to reduce lead time without sacrificing the value of products and services. Industry 4.0 has provided small business owners with an opportunity to save time. The findings of the current study support those of Mathe (2021) who mentioned one of the 4IR technologies being the Artificial Intelligence (AI), the author stated that employing AI is intended to eliminate the time-consuming and tedious process of patient care while making room for faster diagnoses.

A report by PC4IR (2020) also concurs with the findings of this study by stating that 4IR systems, enhance healthcare services, Internet of Things (IoT) and mobile payments allows consumers to save time and money.

5.6.2 Cost saving

A SARChI Industrial Development Working Paper written by Alexander (2021) elucidated that the cost to operate or expand a business has been reduced by the 4IR system, for example, information goods may consume very limited storage space. This study revealed that Industry 4.0 has presented entrepreneurs with an opportunity to save on various types of cost, such as salary, since these automated technologies allow the business to operate at full capacity with less employees, reduction in the capital cost. These cost reduction arise from online business that are being established, travel costs since business meetings can be conducted virtually and less productions costs as machines can be configured and automated to oversee the production.

The findings of this study also align with Oyebanjo and Tengeh (2021) who established that Artificial Intelligence is anticipated as one of the 4IR technologies that will present problem-solving opportunities which will lead to cost-savings for entrepreneurs through innovation and improving the needed socio-economic growth to help gear global economic transformation.

5.6.3 Increased productivity level

The findings evidenced that entrepreneurs who have already implemented the 4IR technologies are benefiting from the increase in the level of productivity. The study found that some entrepreneurs are taking advantage of mass production using automated and configured technology and other entrepreneurs now have quick response capabilities due to the automated business operation.

Similar findings were obtained from a study conducted by Petrillo *et al.* (2018); the authors mentioned that 4IR technologies will bring about smart factories with more advanced customised product development that will present opportunities and also improve production efficiency and promote flexible operations. The findings by Akileswaran (2019) also corroborates these findings as the scholar established that employing 4IR technologies such as AI, Big data, Block-chain, robotics and sensors will improve the level of productivity.

5.6.4 Job creation

It is evident that the introduction of new and advance technology will replace some roles or human workforce, however the study also found that some of these 4IR technologies will not only replace some jobs but they will present new employment opportunities as they will need human workforce to maintain, code or program these new technologies. These findings are contrary to results from Akileswaran (2019) who argued that there is fear that the 4IR technologies are replacing the human workforce and as automation of manual work become mainstreamed, low-skilled repetitive jobs would be phased out and there would be transformation of the very nature of work.

The findings of this study are supported by Corfe (2018) who suggests that there is a possibility that the 4IR may yield different outcomes to past technological changes and it is highly possible that the on-going debate is overstating the negative impact of automation on employment, while understating the potential levels of new employment.

5.6.5 Narrow location gap and increased accessibility

With regards to the narrowing of the location gap, the study found that the 4IR technologies present an opportunity for entrepreneurs and their customers to enter into a business transaction online and also join in virtual meetings. The level at which entrepreneurs used to access customers online has also increased and the pandemic has also played a role in forcing customers to start booking consultations online and have service delivery while sitting in the comfort of their homes.

5.6.6 New income stream and new businesses

The fourth industrial revolution (4IR) has also presented an opportunity for entrepreneurs to benefit from new streams of income. The new income stream opportunities presented by the 4IR technologies are not widely discussed. Santiteerakul *et al.* (2020) conducted a Smart Technology in Sustainable Agriculture case study in Thailand; the authors concluded that employing Industry 4.0 smart technology in the Agriculture Plant Factory had resulted in an increase in profits and revenue. Other scholars such as Makridakis (2017) and Corfe (2018) focused on the

human workforce side of the opportunity and revealed that AI and other 4IR technologies will increase per capita income.

With regard to new business ventures, the study also found that new AI businesses are being established as a result of the revolution which also makes the process of starting a business a lot easier than before. The findings of this study contradict those of Entrepreneur Square (2019) where it was mentioned that South Africa is without adequate infrastructure to allow participation in the 4IR and this means that compared to developed countries, most entrepreneurs in Africa, including in South Africa, may not be prepared for the 4IR.

5.6.7 Improve Marketing & Sales Campaigns

The study found that employing the new 4IR technologies plays a role in improving marketing and sales campaigns. This complements findings of Kartajaya et al. (2016) who emphasised that the marketing advances to Marketing 4.0 which comprises traditional and digital, are more advanced since they pair machine-to-machine connectivity with human-to-human to fuel more customer engagement. The digital space offers from mass communication opportunity which is fast and cost effective to integrated communication which boosts effectiveness of campaigns (Shkurupskaya & Litovchenko 2016). With regard to sales aspect, findings of the study are in line with Davenport *et al.* (2019) who argued that salespeople can now be assisted by sales bots that improve the sales process.

5.6.8 Digital Marketing increased demand

Digital marketing has been in existence for a while, some businesses have slowly being adopting the digital marketing strategy, however, the new technologies brought about by the 4IR and also the pandemic played a pivotal role in forcing businesses to adopt the digital marketing strategy. This concurs with results of a study done by Parimi (2021) who mentioned content marketing which is one of the elements of digital marketing, highlighting that the latter is taking a lead in the digital space. On the contrary, results from a study done by Guttmann (2021) showed that in 2020 South Africa's participation in digital marketing was 19% which shows a slow growth.

5.6.9 Paperless operations

Entrepreneurs are enjoying the benefit of paperless ways of working as a result of 4IR digitised business operations. Paperless system also reduces head counts or eliminates the need for human workforce which comes at a cost (salary expense); implementation of the paperless system gives an opportunity for businesses to save money and reduce cost. Similar findings were obtained from a study done by Papachashvili (2018) in Georgia, where the digitisation of operations helped to develop paperless trading systems and also allowed a broad platform to lessen trade costs.

5.7 Challenges brought about by the fourth industrial revolution (4IR)

It is evident that the fourth industrial revolution (4IR) brings with it changes which may present both opportunities and challenges in the entrepreneurial arena. This section presents the challenges facing small business as a result of the fourth industrial revolution (4IR).

5.7.1 Cost of production loss

Sharmin *et al.* (2017) established that automation of processes will yield profitability in the business as it will also allow mass production, while Jarbandhan (2017) also found that the 4IR has the potential to usher in success of increased production. While the study admits that the 4IR will result in an increase in the level of production, it is evident that in a country like South Africa where small businesses are faced with situation like power cuts and excessive increase in the price of fuel, entrepreneurs are of the view that automating of business processes will create problems and lead to a reduction of production.

5.7.2 Adaption and adoption

The World Economic Forum Global Competitiveness Report (2018) mentioned that a key aspect to transformation and innovations from the 4IR lies with readiness for the future, hence, how agile businesses, government and individuals are to adapt. Countries such as Singapore, Luxembourg, United States, United Arab Emirates and some Gulf nations featured in the report, unlike the African countries. The report noted that lack of skillsets can make employees feel like victims of the

transformation. This study established that entrepreneurs find it difficult to adapt to changes and also to implement advanced technologies. South Africa, hence, will experience a delay with regard to the adoption of these technologies as a result of lack of adequate skillset and infrastructure.

5.7.3 Recognising the need to change

The recognition of a need to change is the first step in managing change. This study established that it is challenging for small businesses to recognise the need to change, hence, they are reluctant to implement the advanced technologies brought about by the fourth industrial revolution (4IR). Little has been mentioned in past studies about this challenge.

5.7.4 Uncertainty

Technological advancements introduced in the business arena, create fear of the unknown or uncertainties in entrepreneurs. Some entrepreneurs may have identified benefits brought about the 4IR, however, it remains unclear whether all businesses may benefit from such changes, and this fuels entrepreneurs' fears. Similar conclusions were found in a study conducted by Amaral and Peças (2021) where it was established that unclear economic benefits, unsure returns on digital investments and uncertainty regarding outcomes have led to SMEs not knowing where to start to generate growth and take advantage of the opportunities.

5.7.5 Lack of knowledge/ Misunderstanding/ Misinformation

Amaral and Peças (2021) elucidated that SMEs are experiencing a general lack of clarity, clear operation vision and difficulty regarding grasping the concept of fourth industrial revolution (4IR). This study found that with the on-going fourth industrial revolution (4IR) debate some entrepreneurs are consuming content from unverified sources which may result in misinformation and misunderstanding. The knowledge level about the new advanced technology is still very low.

5.7.6 Insufficient Infrastructure

It is imperative for small businesses to first create a conducive environment with adequate infrastructure to allow a smooth transition as the implementation process

may not be a success without adequate infrastructure. Such findings are supported by Amaral and Peças (2021) who mentioned lack of adequate infrastructure as one hurdle hindering small businesses from implementing the fourth industrial revolution (4IR) technologies. Mhlanga *et al.* (2021) also supported the findings as they found that lack of adequate resources is one of the many challenges associated with non-implementation of innovation from the 4IR. For innovation to be a success, the required infrastructure should be put in place.

5.7.7 High cost of capital and maintenance

In line with the high cost of capital and maintenance, the study found that some entrepreneurs experience financial challenge in acquiring advance technologies and maintaining them. This challenge further hinders small businesses from being competitive in the market. Findings by Kumaresh *et al.* (2022) also corroborate these as they found the fourth industrial revolution (4IR) technologies to be extremely expensive to set up. Similarly, Amaral and Peças, (2021) admitted that there is a high cost of maintenance of advanced technologies.

5.7.8 Lack of free 4IR - based business incubation initiatives

In this line of thought, findings of the study revealed that there is lack of free fourth industrial revolution (4IR) - focus business incubation initiatives in place to support small business with more information and adequate training to fuel the implementation of the new technologies. This point has not yet been supported by other studies, however, this study established that it is important to put measures in place for small businesses' continuous support.

5.7.9 Hacking and Cyber Crime challenges

Data security remains a major concern as there are unsolved questions around data privacy and such concerns may deter businesses from digitising their processes (Amaral and Peças, 2021). Kumaresh *et al.* (2022) pointed out that 4IR technologies have made secure data prone to cyber-attacks and crime. On this point, this study's results align with those of Amaral and Peças, (2021) and Kumaresh *et al.* (2022) as this study established that businesses are skeptical to implement advanced

technologies brought about by the 4IR due to fear of cyber-crimes. Consumers may also find it difficult to share their information with businesses.

5.7.10 Power or Electricity cuts

The findings from the study revealed that small businesses in South Africa are facing challenges of power or electricity cuts. This challenge causes lower production and forced closure of business operations. Entrepreneurs are considering other options such as making use of solar-generated power and generators, however, finances to fund such options are also another challenge.

5.7.11 Lack of operating skills

Amaral and Peças (2021) elucidated that lack of skilled labour and economic benefits are the inherent challenge facing SMEs forcing non-implementation of advanced technologies. The scholars noted that SMEs implement digital processes without changing employee's working habits. Such findings are also validated by this study as small businesses are experiencing a challenge from lack of operating skills needed for these advanced technologies; the challenge has been identified as affecting productivity and to an extent the quality of production. These advanced technologies require the skills of the current workforce to improve and evolve as well.

5.8 Chapter summary

This chapter presented the findings of this study in comparison with the review of literature. Concurrences and contradictions of those of past scholars and current research findings were presented in this chapter. The following chapter will provide summary, recommendations for further research and conclusions from the findings of this study.

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Chapter overview

The study's justifications, review of literature, research methodology, data analysis and the findings of the study were thoroughly discussed in the previous chapters. The whole study will be concluded on this chapter, therefore, concluding remarks, limitations of the study and recommendations for future studies forms part of this chapter.

6.2 Introduction

Chapter 1 introduced the research aim - to investigate the 4IR technologies applicable to small businesses as well as their potential changes, challenges and opportunities on entrepreneurship in South Africa. A comprehensive literature review established a gap in the literature on the 4IR technologies applicable to small businesses, potential changes, opportunities and challenges. The study's aim was to address the identified gap and the specific research objectives were formulated as follows:

1. To identify the fourth industrial revolution technologies that are applicable to small businesses in South Africa.
2. To determine the potential changes that the fourth industrial revolution can bring about in entrepreneurial initiatives of small businesses in South Africa.
3. To examine the challenges and opportunities that could be presented by the fourth industrial revolution technologies to small business' operations in South Africa.

6.3 Summary of results

This dissertation has established that there are fourth industrial revolution (4IR) technologies applicable to small businesses. Of these, the most common ones were – 3D printer (printers), artificial intelligence (AI), cloud computing, 5G & Wi-Fi - and other technologies that some entrepreneurs thought were also brought about by the new revolution, however, the technologies were already available before 4IR. These technologies were - Uninterrupted Power Supply (UPS), Swiping card machines, Online invoicing technology and Web application. These results substantiate findings

from previous scholars who have investigated the 4IR technologies applicable to small business (Sutherland 2020, Zhang *et al.,* 2021, Abeliansky *et al.,* 2020, Oke & Fernandes, 2020, Martinelli, Mina & Moggi, 2021, Amaral and Peças, 2021, Beáta *et al.,* 2020, Schwab, 2016, Penprase 2018, Chavhan 2022, Alsenwi *et al.,* 2021).

Past scholars have acknowledged that the fourth industrial revolution (4IR) brings with it changes to the general way in which businesses are conducted, the levels of production, profitability and the structure of the business (Pató *et al.,* 2022, Kagermann *et al.,* 2013, Becker & Stern, 2016, Xing & Marwala, 2017, Bordas, 2022, Venturini, 2019, and Tchamekwen, 2019). This research also found that there are potential changes facing small businesses as a result of the fourth industrial revolution (4IR). Of the established potential changes, the common ones suggested by the participants include - technological change, structural change, business model change, productivity change, profitability and income change, barriers to market entry change, and strategic change.

The study also revealed that the fourth industrial revolution (4IR) has presented small businesses with opportunities. Some entrepreneurs who have already implemented some of the advanced technologies have already benefited and seen growth in their business. The most frequent opportunities were - time saving, cost saving, increased productivity, job creation, narrow location gap, paperless operation, new income stream and businesses' increased accessibility, digital marketing increased-demand, online invoicing technology, and improve marketing and sales campaigns.

The introduction of new advanced technologies has presented small businesses with challenges and opportunities. These results revealed that entrepreneurs are faced with both challenges and opportunities brought about by 4IR-advanced technologies. The challenges included - cost of production loss, problems with adaption and adoption, recognising the need to change, uncertainty, lack of knowledge/ misunderstanding/ misinformation, insufficient infrastructure, high cost of capital and maintenance, lack of free 4IR-based business incubation initiatives, hacking and cyber-crime, power or electricity cuts and lack of operating skills.

6.4 Conclusion on research questions and objectives

The chapter continues with a discussion of the research results by answering the established research questions on which this study was formulated. The literature review in Chapter 1, indicated the following research gap**:**

> *Previous literature has specifically focused on the impact of the 4IR from an economic perspective (Gillwald, 2019; Baskin & Schiolin, 2019) thus, how it would impact the economic initiatives of countries, although scholars like Slusarczyk (2018) have focused on the reality of the 4IR in the industry, in general. These debates are ongoing as the notion has not been fully addressed in the body of knowledge, for instance, its impact on entrepreneurship. The 4IR technologies applicable to small businesses, potential changes, challenges and opportunities they would bring to small businesses, hence, have not yet been adequately addressed in academic literature. This study will, therefore, help to fill the dearth of information in academic literature on this topic.*

The study argues that there are several 4IR technologies applicable to small businesses; these advanced technologies will enable small businesses to achieve growth and profitability and compete in the market. Furthermore, the study argues that small businesses in South Africa are experiencing changes as a result of the fourth industrial revolution (4IR). The study provided an in-depth understanding of opportunities and challenges brought about from the introduction of the 4IR technologies in the business arena. The following problem statement was formulated from a review of the gap in the literature:

Unlike the advanced countries which have been gearing themselves for the fourth industrial revolution, the phenomenon has come as a shock to some African countries (Slusarczyk, 2018); likewise, South Africa is not an exception. This brings the question as to whether South Africa is also preparing itself for this industrial revolution, what are the 4IR technologies applicable to small businesses and the potential changes, challenges, and opportunities this will bring to the country's small businesses.

Literature is inconclusive on the impact of the 4IR on small businesses. There are those who believe it would have significant benefit for the industry (for example, Slusarczyk, 2018) whilst others argue that the notion of 4IR is detrimental to small businesses and to nations like South Africa; amongst the latter are Gillward (2019) and Baskin & Schiolin, (2019). Considering 4IR as an imposed global template, researchers stress that a developing country like South Africa needs appropriate technologies and ideas, not the imposition of global templates like the 4IR. The question whether the 4IR is a good notion or not, and how it would impact entrepreneurship initiatives, is still a contentious issue, particularly for businesses in South Africa. The current study will, therefore, contribute to this continuing debate.

Thereafter, the study formulated the following research questions in order to successfully address the identified research gap and problem:

RQ1: What are the fourth industrial revolution technologies applicable to small businesses in South Africa?

RQ2: What are the potential changes that digital transformation can bring about in the entrepreneurial initiatives of small businesses in South Africa?

RQ3: What challenges and opportunities could the fourth industrial revolution technologies present to small business operations in South Africa?

These questions led to the formulation of the following research objectives:

1. To identify the fourth industrial revolution technologies that are applicable to small businesses in South Africa.
2. To determine the potential changes that digital transformation can bring about in the entrepreneurial initiatives of small businesses in South Africa.
3. To examine the challenges and opportunities that could be presented by the fourth industrial revolution technologies, to small business' operations in South Africa.

6.4.1 Conclusion to research question 1

Concerning research question1: **RQ1:** *What are the fourth industrial revolution technologies applicable to small businesses in South Africa?* the study investigated the 4IR technologies that are applicable to small businesses operating in South

Africa. The study established that the implementation level of the 4IR by small businesses is still very low in South Africa. It was noted that different small businesses implemented or planned to implement different advanced technologies that are applicable to their respective operations or needs. The common ones were 3D printer (printers), artificial intelligence (AI), cloud computing, 5G & Wi-Fi.

Other technologies mentioned by entrepreneurs who participated in this study were Uninterrupted Power Supply (UPS), swiping card machine, online invoicing technology and web applications. These technologies existed before the introduction of the fourth industrial revolution (4IR), however, it is possible that the 4IR may have upgraded some of these technologies. It is evident that entrepreneurs operating small businesses in South Africa are still in need of more information and guidance in order to ensure that they implement relevant 4IR technologies which are applicable to their businesses. Implementation without clear understanding will result in failure and hinder business operations.

6.4.2 Conclusion to research question 2

With regard to research 2: **RQ2:** *What are the potential changes that digital transformation can bring about in the entrepreneurial initiatives of small businesses in South Africa?* The study revealed that small businesses operating in South Africa may be faced with both positive and negative potential changes as a result of the fourth industrial revolution (4IR). Entrepreneurs suggested these current and potential changes - technological change, structural change, business model change, productivity change, profitability and income change, barriers to market entry change, and strategic change.

6.4.3 Conclusion to research question 3

In line with Research question 3: **RQ3:** *What challenges and opportunities could the fourth industrial revolution technologies present to small business operations in South Africa?* To answer this research question, this study found that the fourth industrial revolution (4IR) has presented small businesses with both opportunities and challenges. Entrepreneurs who have implemented some of the 4IR advanced technologies have seen benefits, although, they have also experienced challenges. The study established both views from entrepreneurs who have implemented and

ones who are still planning on implementing the advanced technologies in their business operations.

The most established opportunities presented by the 4IR to small businesses were - time saving, cost saving, increased productivity, job creation, narrow location gap, paperless operation, new income stream and business, increased accessibility, digital marketing increased demand, online invoicing technology, and improved marketing & sales campaigns. The study established that challenges introduced by the fourth industrial revolution (4IR) include - cost of production loss, difficulties with adaption and adoption, recognising the need to change, uncertainty, lack of knowledge/ misunderstanding/ misinformation, insufficient infrastructure, high cost of capital and maintenance, lack of free 4IR-based business incubation initiatives, hacking and cyber-crime challenges, power or electricity cuts and lack of operating skills.

6.5 Conclusions on the research problem and contribution to the body of knowledge in the area of research

The research problem investigated in this study was:

> *Unlike the advanced countries which have been gearing themselves for the fourth industrial revolution, the phenomenon has come as a shock to some African countries (Slusarczyk, 2018); likewise, South Africa is not an exception. This brings the question as to whether South Africa is also preparing itself for this industrial revolution, what are the 4IR technologies applicable to small businesses and the potential changes, challenges, and opportunities this will bring to the country's small businesses.*
>
> *Literature is inconclusive on the impact of the 4IR on small businesses. There are those who believe it would have significant benefit for the industry (for example, Slusarczyk, 2018) whilst others argue that the notion of 4IR is detrimental to small businesses and to nations like South Africa; amongst the latter are Gillward (2019) and Baskin & Schiolin, (2019). Considering 4IR as an imposed global template, researchers stress that a developing country like South Africa needs appropriate technologies and ideas, not the imposition of global templates like the 4IR. The question whether the 4IR is a good notion or not, and how it would impact entrepreneurship initiatives, is still a*

contentious issue, particularly for businesses in South Africa. The current study will, therefore, contribute to this continuing debate.

Past scholars have explored the 4IR impact on small businesses on a large scale in developed countries with little focus on developing countries. The question remains whether a developing country like South Africa is preparing itself for the 4IR and how this revolution will impact small businesses. The study has filled this gap and established an understanding of the impact 4IR would have on entrepreneurship and small businesses operating in Gauteng at Ekurhuleni Local Municipality and Mpumalanga at Bushbuckridge Local Municipality. The study established that some small business owners in South Africa have already taken advantage of the advanced technologies brought about the 4IR; however, the implementation is still very low. Other entrepreneurs are still gearing themselves for the implementation. The study also acknowledges that there is still work to be done by policy makers and small businesses' support systems regarding the 4IR information and guidance. .

The study identified that the 4IR technologies applicable to small businesses include - 3D printer (printers), artificial intelligence (AI), cloud computing and 5G & Wi-Fi. The findings, however, showed that not all entrepreneurs are aware of the 4IR advanced technologies applicable to their small business operations. It was found that the 4IR potential changes in the entrepreneurial arena were - technological change, structural change, business model change, productivity change, profitability and income change, barriers to market entry change, and strategic change. The study noted that entrepreneurs were positive about these changes on their small businesses as the 4IR has introduced both opportunities and challenges in the business world.

6.5.1 Contributions of the study to the body of knowledge in the area of research

1. From the gap found in the literature, the established the impact of the fourth industrial revolution (4IR) on entrepreneurship and small businesses operating in Ekurhuleni Local Municipality (Gauteng) and Bushbuckridge Local Municipality (Mpumalanga).
2. The information gathered has the potential to help small business owners understand the type of 4IR-advanced technologies applicable to their

businesses and what changes, opportunities and challenges they should expect from this transformation. Entrepreneurs will be able to make informed decisions that will benefit them and their businesses.

6.6 Implications for practice and recommendations for affected or involved parties

The study seeks to assist different stakeholders involved or affected by the impact of the fourth industrial revolution (4IR) on small businesses. The identified parties include the entrepreneurs, family members and society at large as well as policy makers.

6.6.1 Entrepreneurs

The fourth industrial revolution (4IR) is inevitable and is already impacting the entrepreneurial arena. For entrepreneurs to make informed decisions, it is imperative for them to understand the applicable 4IR technologies, recognise change and create a conducive environment to allow for a smooth transformation as well as take advantage of the opportunities brought about by the 4IR. It was observed that not all entrepreneurs are aware of the 4IR advanced technologies applicable to their businesses. It must be noted that this transformation will bring with it new challenges. The study, therefore, recommends that entrepreneurs should search for more information from relevant and reputable sources in order to avoid misinformation and misunderstandings. Education and training on the 4IR is also recommended as it will provide 4IR related skills to the entrepreneurs, University of Johannesburg (UJ) is currently providing free online Artificial Intelligence (AI) course which is called ‘introduction to Artificial Intelligence in the 4IR’. Attending and participating in business seminars or conferences focusing on the 4IR is also encouraged.

6.6.2 Policy makers

The study will be of value to policy makers and serve as a guide when they are designing and implementing small-business-focused policies. A recommendation would be that policymakers should implement necessary tech-related policies that will work towards providing adequate support to small businesses. The study

established that some entrepreneurs are reluctant to invest in 4IR advanced technologies due to lack of adequate infrastructure in South Africa to encourage the implementation.

Financial challenge was another major factor affecting the implementation. The study further recommends policy makers to put measures in place to mitigate factors hindering the implementation of the 4IR advanced technologies by small businesses. Government should develop forums and workshops for better communication of knowledge with regards to the 4IR advanced technologies applicable to small businesses and support them as they experience changes, opportunities and challenges.

6.6.3 Family members and society

Society and family members have a key role to play in ensuring that small business successfully navigates this new tech-driven transformation. With the on-going 4IR debate, family members and society should ensure that they support small business owners with accurate information from reputable sources. They can also be a financial support system as some entrepreneurs need finances to gear their businesses with 4IR-advanced technologies.

6.7 Limitations of the study and directions for future research

This dissertation suffered some limitations:

1. The scope of the study was restricted to Bushbuckridge Local Municipality and Ekurhuleni Local Municipality; therefore, findings might not be generalisable to other areas in South Africa, to the rest of Africa or other developing countries/emerging economies. Nevertheless, some generic conclusions might be derived from the study, albeit with extreme caution.
2. The study used a qualitative research approach and it is without statistical conclusions regarding the impact of the fourth industrial revolution (4IR) on entrepreneurship and small businesses.

6.7.1 Directions for future research

The findings of this study have the potential to be of value to other researchers in understanding the impact of the fourth industrial revolution (4IR) on entrepreneurship and small businesses in South Africa. There is an opportunity to conduct similar study with other municipalities in other provinces in South Africa as this might provide different views that may be of value in the book of knowledge. For future studies, it is hoped that a quantitative approach be taken to conduct similar study in order to generate more understanding of the phenomenon and draw statistical conclusion.

The purpose of this research was to understand impact of the fourth industrial revolution (4IR) on entrepreneurship and small businesses operating at Ekurhuleni Local Municipality and Bushbuckridge Local Municipality. This chapter presented conclusions and recommendations based on both the existing literature and current results. The contributions of the study on the book of knowledge and resolution of the research problem were also presented in this chapter. The summarised findings as provided from the data collected and analysed, indicated the fourth industrial revolution (4IR) technologies applicable to small businesses, the potential changes, opportunities and challenges brought about by the 4IR. This chapter concludes the study.

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ANEXURE A: INTERVIEW GUIDE

University of Venda

INTERVIEW GUIDE

for the

Research Project entitled:

AN ANALYSIS OF FORTH INDUSTRIAL REVOLUTION (4IR) AND ENTREPRENEURSHIP IN SOUTH AFRICA: OPPORTUNITIES AND CHALLENGES.

COMPILED BY: Tshembo Ngomana

Dear Participant,

My name is Tshembo Ngomana and I am a student (Master of Commerce in Business Management) at the University of Venda. In order to complete my project, I am inviting you to participate in the research titled: **"An analysis of Fourth Industrial Revolution (4IR) and entrepreneurship in South Africa: Opportunities and challenges."**

The research questions formulated for the study are:

RQ1: What 4IR technologies are applicable to small businesses?

RQ2: What are the potential changes that the 4IR can bring about in the entrepreneurial initiatives of small businesses?

RQ3: What challenges and opportunities could the 4IR technologies present to small business operations?

The following ethical standards will be followed throughout the research process:

a) This study is anonymous and voluntary, and all information obtained will be confidential.
b) You can withdraw from the study at any time without prejudice.
c) All information gathered will be treated as group data and no individual will be reported on.
d) This research is in accordance with the rules and regulations of the University of Venda research guidelines, and the researcher will not misuse his position for personal power or gain.
e) This research is not intended to harm the respondents or their businesses.
f) Only respondents who are 20 years and above are allowed to participate in this study.

Be assured that all the information gathered from you will remain confidential.

If you are willing to participate in this interview, please sign below:

Signature……

Date……

Thank you for your participation

Yours sincerely,

Tshembo Ngomana
Email: tshembongomana@gmail.com Cell phone number: 071 630 6133

Section A: Fourth Industrial Revolution

Please note the questions provided below serve as a guideline, questions might be rephrased or changed during the discussions process to solicit more information and to probe. The questions are aligned to the above research questions and also divided into areas of inquiry to assist the researcher in answering the questions.

1. Based on your own understanding what constitutes the fourth industrial revolution?

2. Personally, how would you define the fourth industrial revolution?

Probing questions

a) Is 4IR avoidable?
b) How can one avoid 4IR?

3. What are your perceptions regarding the fourth industrial revolution notion?

Section B: Conceptualisation of fourth industrial revolution effect on small businesses.

1. What are the 4IR technologies are you planning or have already implemented in your business?

2. What changes has the 4IR introduced in the business and entrepreneurial arena?

3. What are the opportunities that 4IR brings to your business?

4. In your opinion to what extent are these opportunities benefiting your business?

5. What are the challenges that your business is facing regarding the fourth industrial revolution?

6. In your own opinion to what extent are these challenges hindering your business operations?