UNIVERSITY OF KWAZULU-NATAL

An exploratory study of human-robot collaboration's potential to create sustainable enterprises in Durban

By

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DECLARATION

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ABBREVIATIONS

AI	Artificial Intelligence
COBOT	Collaborative Robot
CPS	Cyber Physical Systems
ICT	Information and Communication Technology
Industry 4.0	Fourth Industrial Revolution
IOS	Internet-of-Services
IOT	Internet-of-Things
NCR-	National Credit Regulator
NVIVO	Navigating viewpoints, images and values observed by informants or interviewees
SME	Small-to-Medium Enterprises

ABSTRACT

SMEs are encountering challenges transitioning into the fourth industrial revolution and ultimately adopting technology that will work with humans to ensure they engage in sustainable business practices. The challenges SMEs are battling with are the ability to deal with economic, environmental and social changes, responsibly and efficiently using natural resources and protecting the environment, providing high-quality products and services and meeting stakeholder needs. Therefore, this study will be of benefit in that it has explored how the use of collaborative robotics in the workstation and manufacturing floor will lead to sustainable production which will ultimately balance between the economic, environmental and social sustainability among Durban SMEs. The study adopted a qualitative approach using six in-depth telephonic and video interviews to gather insights about the human-robot collaboration's potential to crate sustainable enterprises in Durban. Thematic analysis was used to analyse data. The study's findings indicated the obstacles that businesses are encountering as they migrate to Industry 4.0. Lack of resources, such as financial capital, machinery, and more information on Industry 4.0, are among these problems. Furthermore, the study revealed that the Covid 19 pandemic was a significant stumbling block for SMEs. The results revealed that adoption of collaborative robots by SMEs will create a sustainable environment which produces less waste and less depletion of non-renewable resources, enable enterprises to make more profit while taking care of the wellbeing of the societies they operate in. The study concludes that the collaboration between humans and collaborative robots will solve sustainability challenges faced by Durban SMEs. Likewise, collaborative robots and humans will enable sustainable entrepreneurship to be geared towards the implementation of green strategies and techniques that are more efficient in the reduction of waste. The recommendations pointed that the government (SEDA) should raise awareness and educate entrepreneurs more about the fourth industrial revolution.

KEYWORDS: Collaborative robots (Cobots), Covid 19, Industry 4.0, Small-to -Medium Enterprises, Sustainability

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

Technology has a tremendous impact on the world; it allows firms to create in massive quantities, which is likely to lead to waste overproduction. On the other side, technological developments reduce the amount of burden placed on the environment, reducing negative consequences such as excessive pollution levels, among other things. Furthermore, environmental changes have influenced the evolution of life through the scarcity and depletion of natural resources that contribute to society's well-being, and technological advancements have also influenced the environment's sustainability. (Demi, Doven and Sezen, 2019). Furthermore, SMEs must develop more ecologically beneficial and long-term farming, food, and energy technologies. Furthermore, the development of sustainable smart cities and industrial innovations, which is the gold standard for human well-being (Demi et al., 2019; Skolebev and Borovik, 2019).

In terms of the preservation of finite resources, the change and restoration of the earth and the pattern of creation will be resourceful for future generations. As a result, the future's well-being is dependent on the development of technology capable of governing the planet's climate, health, social fairness, and stability (Berawi, 2019; Nahavandi, 2019).

Furthermore, sophisticated technologies such as the Internet of Things (IoT), big data analytics, artificial intelligence, machine learning, and 3D printing are being utilized by enterprises all over the world to assess the efficacy of sustainable development and environmental compliance (Berawi, 2019). The research will investigate the existing use and future deployment of collaborative robots in workstations or production floors, in accordance with the fourth industrial revolution. Therefore, this study will investigate the manner on which Durban SMEs have encountered challenges in being in the fourth industrial revolution and how SMEs can overcome hinderances of adopting collaborative robots. Furthermore, the usage and future prospects of adopting collaborative robots as part of SMEs manufacturing that will ensure they engage in sustainable entrepreneurship.

1.2. Background of the study

Since the Brundtland Commission and the United Nations proposed the notion of sustainability in 1987, numerous countries and corporations have tried to define it and its significance in their corporate operations, values, and functions. As it was proposed in the 1980s, this notion is constantly evolving, and most businesses are still learning about its multidimensional and complicated nature (Khalidi et al., 2015; Severo et al., 2015). Furthermore, Frazee (2019) highlighted that it is impossible to become a sustainable business since selling fewer items would result in lower earnings because customers would consume less things, which is in direct opposition to their business methods of selling more and profiting. Furthermore, while many firms claim to be environmentally friendly, only a handful can

demonstrate that their activities do not harm the environment. In contrast, the International Institute of Sustainable Development (2019) argued that a sustainable business addresses all sustainability dimensions equally, and that by caring for the society it operates in, protecting the environment's well-being while reaping economic returns, a sustainable business attracts a large customer base and establishes a good reputation as various stakeholders associate themselves more with a business that is committed to sustainability.

Furthermore, due to limited expert control capacities and frameworks, as well as concentrated decision-making by owners or managers, small to medium sized firms face difficulties reconciling environmental, economic, and social sustainability. Similarly, a lack of qualified human capital, employee disengagement, inadequate reporting, a lack of internal tracking and maintenance systems, a risky budget, and insufficient investment assets are also factors to consider (Khalidi, Daya, Hashash and Jabareen 2015).

According to a study conducted by Jayasundara et al. 2019, the factors capable of stimulating an imbalance between social, economic, and environmental sustainability are a country's political-economic changes, globalization, and adapting in the modern era of advanced technology and artificial intelligence. Furthermore, (Auwal, Mohamed, Shamsudin, Sharifuddin, and Ali, 2018) said that SMEs in the current world are not only challenged in comparison to bigger firms, but also face a variety of issues since they are more vulnerable to external external downturns. As a result, establishing a sustainable company while being competitive in a dynamic and competitive market is tough for SMEs.

Sustainability refers to a company's capacity to grow and succeed in a competitive business environment. It depends on how the firm meets the demands of individuals who want to see the company prosper (Moscha, 2018). The business model must obviously be sustainable; otherwise, even if the company's purpose is to be environmentally friendly, the commercial objective may be unsustainable. As a result, the World Commission on Environment and Development (WECD) recommended that businesses aim for a balance in their goods, operations, and policies between environmental preservation, economic development, and social sustainability (Masocha, 2018).

Due to factors such as the ability to address economic and social change, participate in responsible and ethical business practices, use natural resources more efficiently and conserve the environment, deliver high-quality goods and services, and build measures to assess whether the organization meets stakeholder needs, SMEs are constrained to balance between the three pillars of sustainability. The sophisticated technologies brought by the fourth industrial revolution, such as collaborative robots helped by artificial intelligence, are the envisaged solution to tackling the sustainability concerns (Jayasundara et al., 2019).

Furthermore, the interaction of people and robots will have a favorable impact on the economy, the environment, and society. As a result, industrial upcycling (reusing waste matter leftovers in a way that produces a higher-quality product) is accompanied by a waste avoidance approach (Mikus, Gotze & Schildt, 2019). As a consequence, physical trash, urban waste, process waste, and social waste will be eliminated (Rada, 2018).

1.3 Research Problem

SMEs play a pivotal role in the economy with the goods and services they offer (OECD, 2019). However, SMEs a faced with the challenge of being fully into the fourth industrial revolution, which translates to SMEs not being able to adopt collaborative robots (Callitz, Poisat and Cullen, 2019).

It is assumed that the introduction of collaborative robots into African enterprises would result in the displacement of human work, resulting in job losses. Collaborative robots are expected to create a lot of interest in the manufacturing business, especially in Africa. Collaborative robots do operations such as machine tending, material handling, assembly activities, and packing. Picking, placing, counting, and inspecting are just a few of the tasks that Cobots may perform (Strohkorb & Scassellati, 2016).

Furthermore, according to the results of Nahavandi (2019); Simoens (2019) and Berawi (2019), SMEs in developed countries such as Germany, America, and China have adopted robots in their manufacturing processes and factory floors, leading to more sustainable entrepreneurship and attempting to balance the three capitals of social, economic, and environmental capitals. Further to this, Durban SMEs as the point of focus of this research have not fully transitioned into the fourth industrial revolution, thus encountering challenges to adopt robotics to work along humans in their factory floors. As a result, the Durban SMEs are hindered in engaging in sustainable entrepreneurship as they cannot balance the three capitals of sustainability.

Therefore, this study will investigate the manner on which Durban SMEs have encountered challenges in being in the fourth industrial revolution and how SMEs can overcome hinderances of adopting collaborative robots. Furthermore, the usage and future prospects of adopting collaborative robots as part of SMEs manufacturing that will ensure they engage in sustainable entrepreneurship, thus reducing waste, taking care of the society they operate in while reaping economic returns.

1.4 Research Questions

1.4.1 What are SMEs perception about the fourth industrial revolution**?**

1.4.2 What are the challenges that are hindering SMEs from transitioning into the fourth industrial revolution and taking advantage of the use of collaborative robots?

1.4.3 How will SMEs overcome the challenges of fully transitioning into the fourth industrial revolution?

1.4.4 How will the current use of collaborative robots lead to sustainable entrepreneurship?

1.4.5 How will the future implementation of collaborative robots enhance manufacturing on the factory floor?

1.5 Research Objectives

1.5.1 To determine SMEs perception of the fourth industrial revolution**.**

1.5.2 To determine the challenges that are hindering SMEs from transitioning into the fourth industrial revolution and take advantage of the use of collaborative robots.

1.5.3 To determine a way the SMEs will overcome the challenges of not fully transitioning into the fourth industrial revolution.

1.5.4 To determine a way the current use of collaborative robots will lead to sustainable entrepreneurship.

1.5.5 To determine a way the future implementation of collaborative robots will enhance manufacturing on the factory floor.

1.6. Literature Review

Small and medium-sized businesses (SMEs) are important players in the global economy, as evidenced by the critical role they play in achieving the Sustainable Development Goals (SDGs) by fostering sustainable economic growth, job creation, industrialization, and the reduction of income disparities, among other things (OECD, 2017). Furthermore, environmental sustainability, often known as lean, has become a popular method for businesses to improve efficiency (Dombrowski, Richter and Krenkel, 2018).

Furthermore, SMEs are characterized in a variety of ways based on several factors such as location, size, age, organizational structure, number of employees, sales volumes, asset count, and ownership in terms of innovation and technology. The majority of SMEs use basic processes and procedures that

allow for flexibility, fast response, and short decision-making chains. Furthermore, SMEs are reported to respond to client requirements more quickly than their larger competitors (Ghazilia, Sakundarini, Hanim, Abdul-Rashid, Ayub, Olugu, and Musa, 2015).

1.6.1 Sustainability

According to Eizenberg and Jabaren (2017), social sustainability is often centered on the 1987 Brundtland Commission Report, which described sustainable development as emphasizing human livelihoods as crucial in achieving ecological goals through economic development that strives to meet the needs of current generations without jeopardizing future generations' ability to meet their own needs. According to Thompson (2015), sustainability is defined as the efficient allocation and deployment of goods intra-generationally and inter-generationally through time when economic activities are carried out in a finite ecosystem. Sustainability, according to (Littig & Griebler, 2005), is the link between economic, environmental, and social sustainability. The specific link between the three pillars of sustainability, however, is unknown. Sustainability, according to Brown, Dillard, and Marshall (unpublished), is a natural system that provides the backdrop for and maintains social systems, and as such, it must be recognized, nurtured, and preserved. Economic systems have a context and a purpose because of social systems. The economy, in plain words, is the foundation and component of society and environment.

Economic sustainability necessitates both environmental and social sustainability, according to a research by Van der Vorst, Grafe-Buckens, and Sheate, while social sustainability is dependent on environmental sustainability. Furthermore, Henriques, as described by Reddy and Thompson (2015), suggested that the three dimensions of sustainability are insufficient, and that stakeholder responsibility should be added as a fourth area. Stakeholder responsibility, on the other hand, should be embedded into all three domains.

1.6.1.1 Environmental Sustainability

The influence of corporations on natural systems is defined as environmental sustainability (Sarango-Lalangui, Alvarez-Garcia, de la Rio-Rama, 2018). Environmental sustainability requires consideration of resource depletion and climate change. Pollutants pollute environmental products such as air, water, and soil, which are utilized for processing. Natural resource conservation should also be a goal for businesses as they create industrial structures and procedures (Mikus, Gotse & Schildt, 2014).

1.6.1.2 Economic Sustainability

Economic sustainability is inextricably tied to environmental and social concerns. The limits of expansion demonstrate this. According to Reddy and Thomson (2015), economies may not be sustainable if natural resources are used far beyond their boundaries and if society continues to rely on occurrences that have driven growth over the years. Growth in population coupled with increased usage of resources above what the environment can sustain can cause environmental, economic, and social degradation or collapse. As a result, the rising risk of instability poses a challenge to the industrial sector in terms of the economic dimension of sustainability. To stay continually competitive in marketplaces, a high level of flexibility is required. However, the trend toward product individualization must be acknowledged, which entails transitioning from mass manufacturing to individual production with rising product(s) diversity (Abele & Reinhart, 2011).

1.6.1.3 Social Sustainability

The social element entails strong corporate governance in the society in which the firms operate, which incorporates the demands of workers and the wider society with the goal of doing business ethically and caring for the livelihood of local communities (Sarango-Lalangui et al., 2018). As a result, on the social aspect, demographic factors pose a difficulty in communities when the firms functioning in their neighborhood do not improve their lifestyles. Furthermore, as technology advances, new skills are required of employees in order to execute their duties, and businesses are obliged to offer the necessary training to their employees. As a result, sustaining worker health and a pleasant working environment is critical today and, in the future, (Abele & Reinhart, 2011).

1.6.2 Introduction of the Advanced Technology by the Fourth Industrial Revolution

The fourth industrial revolution, often known as Industry 4.0, is a build-up of the third. Industry 4.0 is a complicated technical system that has been widely debated and explored, and it has a significant impact on the industrial sector since it introduces vital developments connected to smart and future factories. Similarly, industry 4.0 is a new industrial age that encompasses a number of technological advancements such as Cyber-Physical Systems (CPS), Internet of Service (IoS), Internet of Things (IoT), Big data analytics, Artificial Intelligence (AI), robots, and cloud-based manufacturing, among others (Pareira and Romero, 2017).

1.6.3 Collaborative Robots

Collaborative robots are robots that are designed to execute activities alongside people at a workstation or on a factory floor, thereby achieving sustainability goals (Nahavandi, 2019). When humans and robots are cooperating, people will be able to work comfortably with robots, knowing that cobots

(collaborative robots) understand them and can collaborate with them. As a result, a value-added manufacturing process, trusted autonomy, and decreased waste and expenses will emerge. Similarly, the cobots will be able to learn and will know what to do. The cobots will be aware of the human presence and will therefore assure the safety and avoidance of any hazards that may arise. The collaborative robots will detect and feel not just the human they are working with, but also the human operator's defined goals and expectations. Not only will people learn how robots perform a function, but cobots will also observe and learn how a human operator executes an operation, and once they have mastered it, they will carry out the task themselves (Simoens, 2019).

Furthermore, in a production line, a human operator will work on the assembly of an electromechanical machine, performing a task, while the robot will observe what the human operator is doing using a camera mounted on a gimba, which functions similarly to a robot's camera. The robot is also linked to a computer, which will capture the image(s), analyse them, and then use machine learning to understand the patterns. Using human intention analysis driven by deep learning, the collaborative robot will study the human operator, monitor the surroundings, and predict what the human operator will do next. Furthermore, the functional-near infrared spectroscopy through a wireless communication channel will be employed by the cobots to extract signals in the brain, which is an important sensor for understanding the purpose of the human operator. This is delivered in the form of a headset and requires no setup time (a new form of artificial intelligence). Once the robot is satisfied with the forecast, it will aid the human operator, improving overall efficiency and ensuring long-term sustainability (Nahavandi, 2019; Simoens, 2019).

Human-robot collaboration will revolutionize global production and manufacturing by removing tedious, dirty, and unnecessary work from human operators where possible in order to attain sustainability. Intelligent robotics and systems will have unparalleled access to supply networks. The complicated job between human and technology with direct human involvement in two separate modalities is the focus of human-robot collaboration on the workplace and factory floor. To begin with, there is a physical partnership between humans and technology in which forces are exchanged in an explicit and planned manner (robot). The robot can make an educated guess about the human's purpose and reply appropriately. Second, at the manufacturing floor or workstation, contactless collaboration occurs when there is no physical engagement between the human and the technology or robot. Information sharing, which may be performed by direct communication such as voice and gestures or indirect communication, is used to coordinate activities in this scenario (through facial expression, eye gaze direction). Furthermore, the human operator executes activities that involve dexterity and/or decision-making, while the robot detects components that aren't suitable and exchanges them with a more suitable part in order to achieve long-term sustainability (Hentout, Aouache, Akli, 2019). Furthermore, on the factory floor, safe operating mechanisms will be assured by the intelligent robot's

reliability and faith in the human worker, ensuring faultless output, little waste, and efficiency in the achievement of sustainability (Nahavandi, 2019).

1.6.4 Significance of the study

The study is of paramount importance in that it will propose ways that the SMEs operating in Durban can use in order to balance between environmental, economic and social sustainability in their production. The SMEs have transitioned into the fourth industrial revolution but not fully. As a result, the study will explore human-robot collaboration to create sustainable enterprises in Durban. The Durban SMEs in adopting collaborative robotics will address the sustainability issues that SMEs are battling with which include the ability to deal with economic, environmental and social changes, engaging in responsible and ethical business practices, efficiently using natural resources and protecting the environment, providing high-quality products and services and meeting stakeholder needs. Therefore, the study will explore the benefits of adopting collaborative robotics that will ensure SMEs are being environmentally sustainable, socially sustainable by will adding value, building a good relationship and reputation with society the SMEs operate in while attracting a larger customer base thus being economically sustainable.

1.6.5 Justification

The conducting of the study will address the problem under investigation, whereby SMEs are faced with the challenge of not fully transitioning into the fourth industrial revolution and adopting robotics in their factory floor, which leads to sustainability issues which result in the SMEs prompting sustainability to slide down their list of priorities. The sustainability issues that SMEs are battling with include the ability to deal with economic, environmental and social changes, engaging in responsible and ethical business practices, efficiently using natural resources and protecting the environment, providing high-quality products and services and meeting stakeholder needs. Therefore, this study will be of benefit in that it will explore how the use of collaborative robotics in the workstation and manufacturing floor will lead to sustainable production which will ultimately balance between the economic, environmental and social sustainability. This has been possible in other countries who have adopted the robots in their businesses.

1.7 Research Methodology

Research methodology refers to the systematic techniques that will be employed in research. Rajasekar (2013) defines research technique as the techniques used by researchers to anticipate, explain, and forecast occurrences (Almalki 2016: 290). The study's execution is guided by a research approach. The research method aids the researcher in developing the ability to evaluate research findings and provide a full grasp of the problem (Igwenagu, 2016). Furthermore, the research techniques section is the one

that necessitates the most care (Gray, 2019). The research design, research technique, study site, demographic, inclusion and exclusion criteria, sampling design, sample, and sample size are all part of the research methodology.

1.7.1 Research Design

The actions that must be followed in order to answer the research problem are specified in a research design (Sekaran and Bougie, 2016). It serves as a blueprint or strategic plan for gathering and analyzing data (Dannels, 2018). Research designs include action research, case studies, ethnography, experiments, and grounded theory (Sileyew, 2019). Action research is a type of study that aims to bring about the desired changes. It is a study design element that identifies an issue and attempts to provide solutions to the problem (Sekaran and Bougie, 2016; Igwenagu, 2016). Ethnography is a way of examining the lives of people from other cultures by observing them closely and asking questions in order to have a better knowledge of them (Leavy, 2017). In addition, an experiment is also a form of research study that looks at the relationship between factors. In an experiment, a researcher manipulates the independent variable to discover how it impacts the dependent variable. Survey research, on the other hand, is a method of collecting information from or about people in order to describe, identify, and categorize their knowledge, attitudes, and or behavior.

As a result, case studies will be employed in this study among the numerous sorts of research designs. A case study is a sort of research study that focuses on acquiring information on a particular issue. In case studies, the issue is examined from a variety of perspectives using a variety of data collection methods in order to gain a thorough understanding of the subject or problem (Cresswell and Poth, 2016). In this study, case studies will be employed since they will help the researcher to gain a full, multi-faceted understanding of the complex matter at hand (exploration of the Human-Robot Collaboration Framework potential for sustainability on Durban SMEs).

1.7.2 Research Approach

In its most basic form, research is the process of gathering information and discovering the truth (Sekaran and Bougie, 2014). Formally, research is a scientific investigation of a topic using a method that begins with the selection of a methodology and concludes with the provision of a solution to the research problem. Designing research hypotheses, selecting methodologies and tactics, selecting or developing data gathering instruments, processing the data, interpretation, and finally delivering a solution or answers to the study topic are all part of this process (Grover, 2015:1). The qualitative, quantitative, and mixed methodologies research approaches will all be explored.

1.7.2.1. The Qualitative Approach

Data in the form of words, according to Sekaran and Bougie (2016), is a qualitative research approach. According to Ritchie, Lewis, Nicholson, and Ormston (2013), defining qualitative research is challenging. Qualitative research, on the other hand, is concerned with the predominance of qualities of objects and courses of action that are not examined or assessed empirically, according to (Zikmund, Barbin, Carr, and Griffinn, 2013). According to McCusker and Gunaydin (2015), qualitative procedures are used to answer questions such as what, how, and why a phenomenon happens, rather than how much or how many, which are answered using quantitative methods.

1.7.2.2 The Quantitative Approach

Deductive research approaches are used in quantitative research. Quantitative researchers also see the world as existing outside of themselves, with an objective reality apart from their own observations (Rovai, Baker & Ponton, 2014). Quantitative research may also be thought of as a scientific examination of a phenomena based on the collecting of quantifiable facts. The sampling's findings might be statistical. The surveys allow the researcher to send the questionnaire to the whole target audience through email in a short period of time and at a low cost, and the respondents will not have to put in a lot of effort to complete the questionnaire.

1.7.2.3 The Mixed Methods Approach

The mixed methods approach is characterized in a variety of ways, according to Almalki (2015:3), making it a challenging concept to understand. This is a research approach that combines quantitative and qualitative data into a single or series of studies (Sekaran and Bougie, 2016; Almalki, 2016). The mixed methods approach appeals to researchers because it addresses challenges that quantitative and qualitative research cannot (Cresswell, 2016). Almalki (2015) agrees with Cresswell that a mixed method approach provides a higher degree of understanding than a single strategy.

Out of the three research methodologies, this study will use the qualitative strategy since it allows the researcher to interpret what they see, hear, and understand. The qualitative research method provides for a more in-depth analysis of the research. Furthermore, in the topic of organizational research, the researcher has a wide range of options and opportunities to explore a multitude of issues.

1.8 Study site

The study site is where the research will be carried out (Sekaran and Bougie, 2014). The research will take place in KwaZulu-Natal, specifically in Durban, where the target demographic of small businesses will be identified. The Human-Robot Collaboration Framework has the potential to make Durban's

SMEs more sustainable, decreasing waste and caring for the society in which they operate while making a profit. The Human-Robot Collaboration Framework has the ability to ensure that Durban's SMEs are sustainable, minimizing waste and caring for the society in which they operate while enjoying financial rewards. The study site was chosen because SMEs in Durban have a difficult time balancing the three capitals of sustainability; additionally, the human-robot collaboration framework has the potential to ensure that SMEs in Durban are sustainable, reducing waste and caring for the society in which they operate while reaping economic benefits.

1.9 Target Population

According to Alvi (2016), a target population is defined as people who meet the study's criteria. The study's target group is Durban's small and medium businesses (SMEs).

The target population for this research study will be extracted from the Durban Business Chamber, which has a database of 667 433 recognized Durban businesses.

SME's having a turnover of between zero and fifty million rand will be eligible. These SMEs might be in any industry or in significant industries with a huge number of stakeholders and a visible influence, such as agriculture, manufacturing, automotive, education, and construction, to name a few. The sample size is appropriate for characterizing the phenomena of interest and answering the research questions.

1.10 Sampling Strategies

The process of selecting the most representative persons, objects, or events from a population is known as sampling (Sekaran and Bougie, 2016). The apparent reason for using a sample rather than the entire population is that doing research, collecting data, analyzing, or testing each and every member of a population with hundreds or even thousands of elements would be impossible. Even if it were possible, the amount of time, money, and human resources needed would make it impossible. Similarly, Alvi (2016) asserts that studying a sample rather than the entire population produces reliable results, and that findings are generalizable if they are representative or true for the entire population. The two forms of sampling are probability sampling and non-probability sampling.

When people in a sample have a known chance of being picked, it is called probability sampling (Sekaran and Bougie, 2016). There are two forms of probability sampling: simple random sampling and sophisticated random sampling.

1.10.1 Unrestricted or Simple random sample

This is a type of probability sampling in which each subject's likelihood of being picked for the sample is known and equal. Each subject should also have a listable or mappable component, be mutually exclusive, and homogeneous (Alvi, 2016).

1.10.2 Restricted or complex probability sampling

Sekaran and Bougie (2016) argue that confined or sophisticated probability sampling is more feasible and efficient than unrestricted random sampling. Furthermore, efficiency has improved, and more data can now be collected. Sophisticated probability designs include systematic sampling, stratified random sampling, cluster sampling, area sampling, and double sampling.

1.10.3. Non-probability sampling

In non-probability sampling, the components have no known or predetermined likelihood of being included in the sample (Sekaran and Bougie, 2016). When the sample's representations are particularly essential in terms of generalizability, non-probability sampling is used (Sharma, 2017). Non-probability sampling designs include convenience sampling and purposive sampling (judgement sampling and quota sampling).

Non-probability (convenience sample) sampling will be employed because the study is looking at a topic that isn't well known (the possibility for sustainability of the Human-Robot Collaboration).

1.11. Sample size

The number of people or experimental units in a research study who are representative of the study's real population is referred to as the sample size. The sample size is decided by the level of precision and confidence, according to Sekaran and Bougie (2016). The sample size for the study was also determined by the level of precision and confidence.

The target demographic of 667 433 formal firms in Durban will be used to draw the sample size for this research project. A total of 20 virtual interviews will be held by the researcher (where saturation will be reached on the qualitative study). The sample size is large enough to appropriately address both the phenomena of interest and the research questions.

1.11.1 Sample

A sample is a random selection of a population chosen for research or study reasons. Furthermore, a sample is said to be representative when the characteristics of the chosen elements match those of the entire target population (Alvi, 2016).

1.12 Data collection methods

Data collecting methods relate to the process of acquiring data or information from relevant sources with the purpose of identifying solutions to the research problem (Ingwenagu, 2016). Primary data and secondary data are the two forms of data collected.

1.12.1 Primary data

Primary data is information gathered for the first time by the researcher. Primary data is classified into two types: quantitative data and qualitative data. Figures serve as the foundation for quantitative data collection approaches. Questionnaires can be used to collect quantitative primary data (Sileyew, 2019).

1.12.1.1 Qualitative Primary data collection methods

1.12.1.1.1 Interviews

Data will be gathered through interviews. Interviews, as convoluted as the term may be, may be described as a type of consultation in which the researcher seeks to understand and grasp the perspectives of the participant(s) being interviewed; this consultation is motivated by a valid purpose (Adhabi & Anozie, 2017). Interviews are approaches used in academia to get a deeper knowledge of the world from the perspective of the topic (Sewell, 2017). Regular discussion is included in interviews, whether or not it is focused on the researcher's quest for data. They vary from conventional debates in that they are meticulously carried out to ensure high levels of reliability and authenticity. This means that the researcher, as well as any recipients of data that reflects what the researcher is looking at, must participate (Brick and Green, 2019).

In the study, interviews will be employed to collect qualitative primary data. The telephonic and video interviews would allow the researcher to collect data on the whole target population in a short period of time and at a minimal cost, as the telephonic interview would require little effort from the respondents. The interviews will be conducted virtually due to the COVID 19 Pandemic.

1.13 Data quality control

1.13.1 Trustworthiness of qualitative data

According to Gunawan (2015), in qualitative research, trustworthiness should be linked to truth or value, which are the same concepts used by positivists. Furthermore, according to Gunawan (2015), a study is only credible if the research report's reader feels it is credible. Credibility is further separated into internal validity, dependability, reliability, transferability, which is a type of external validity, and lastly confirmability, which is a presentation issue.

1.13.1.1 Dependebility

Dependability, according to Moon, Brewer, Januchowski-Hartley, Adams, and Blackman (2016), refers to the accuracy and reliability of the study results as well as the extent to which research methods are reported, allowing those outside the study to observe, inspect, and critique the research process. Dependability is an important measure of quality for applications in environmental and preservation sciences that are in the early phases of reviewing research results in different contexts to increase trust in the evidence (Adams et al 2014).

1.13.1.2 Credibility

The amount to which research reflects the real views of study participants, or the "overall meaning," is referred to as credibility. Furthermore, while grading qualitative research, credibility is derived from the study's intended aims, and credible research judgments are compatible with the researcher's objectives, requiring researchers and practitioners to think critically and contextually when reviewing technique (Moon et al., 2016).

Credibility may be demonstrated through tactics such as members verifying findings before returning them to participants to ensure that they match their opinions. Both credibility and reliability apply to all aspects of a research design, including respondent selection, data collection, and the amount of data gathered, all of which have an impact on how successfully research questions may be answered (Moon et al., 2016).

1.13.1.3 Conformability

To achieve confirmability, investigators must prove that the findings are directly tied to the assumptions in a way that can be seen and replicated. Its applicability is comparable to that of credibility, in that confirmability has significant implications for research that make policy recommendations. In terms of how they categorize "facts," the philosophical and epistemological perspective of Qualitative research the problem and the researcher's inclination will be chosen. The researcher will also reveal the steps they have made to control and report on the outcomes of their theoretical or observational interests, if relevant. Finally, by providing a thorough methodological review, the researcher assists the reader in determining confirmability and demonstrating how the data and assumptions derived from it may be trusted (Moon et al., 2016).

1.13.1.4 Transferability

Transferability, which is a type of external validity, refers to how relevant or valuable the phenomena or results discussed in one study are to theory, practice, and future research topics. The study's findings can be used in a variety of situations. Since policy and management can rely on the information, recommendations, and conclusions from a single or small number of research initiatives, and because scientific proof from a variety of contexts that may differ from those in which implementations are made, transferability can be critical to the implementation of research results. As a result, it's critical that researchers state clearly whether or not their findings are relevant in different circumstances. Similarly, the qualitative research methodology and review must demonstrate why the study can be (transferred) to the initial claim (Moon et al., 2016).

To ensure that the study (interviews) is reliable, the study will ensure credibility by testing what the study intends to test, ensure that the study is transferable to other settings, report the findings in detail so that a future researcher can evaluate or repeat the work to obtain the same dependable results, and finally, the findings will be confirmed to demonstrate that they are the informants' experiences and ideas.

1.13.2 Piloting

According to Van Teijlingen and Hundley (2014), a pilot study is a scaled-down version of the main study that is used to examine a specific research instrument, such as a questionnaire or interview. A pilot study is another term for a feasibility study. A pilot study is also an essential component of a solid research endeavor. Despite the fact that a pilot study is conducted, it does not guarantee that the study will be beneficial. A research study has the advantage of providing an early warning of probable failure sites. Pilot studies are used in both quantitative and qualitative research.

The questionnaires were piloted by the researcher in collaboration with an organization that represents small businesses; the researcher administered the questionnaire to pilot subjects in the same way that it was administered in the main study; the researcher solicited feedback from the pilot subjects to identify ambiguities and difficult questions; the researcher recorded the time it took to complete the questionnaire and determined whether it was reasonable; and the researcher discarded all unnecessary, difficult, or ambiguous questions. Checked that all questions had been answered, and reworded or rescaled any which had not been answered correctly.

1.14. Data Analysis

Data analysis is a technique for uncovering pertinent information, drawing conclusions, and assisting decision-making by analyzing, cleaning, amending, and modeling data (Sekaran and Bougie, 2014). To investigate qualitative data, thematic or content analysis is performed. The technique of methodically finding, organizing, and disclosing patterns of meaning is known as thematic analysis (Braun and Clarke, 2012). Using theme analysis, the researcher may make meaning of common or shared thoughts and experiences. Material analysis (Roller, 2019:1) is the methodical reduction of material investigated with particular attention to the context in which it was generated in order to find patterns that emerge from the data set and derive meaningful interpretations of the data (Roller, 2019:1).

Quantitative data, on the other hand, is examined using descriptive or inferential statistics. Descriptive statistics is primarily concerned with what appears on graphs, with the purpose of condensing large amounts of data into understandable amounts. Inferential statistics deals with drawing conclusions from a set of data (Sharma, 2019).

The qualitative data will be coded using NVIVO version 12, which is the most recent version. NVIVO is a qualitative data analysis application developed by QSR International that analyzes and generates inferences from unstructured qualitative data such as open-ended surveys, interviews, and journal articles (Sekaran and Bougie, 2016). As a result, thematic analysis will be used in this study because it is flexible and allows the researcher to focus on data in a variety of ways and in depth, reporting the semantic meaning in the data while also interrogating the hidden meanings, assumptions, and ideas that lie beneath the data set.

1.15. Ethical Consideration

The researcher will follow ethical guidelines by seeking approval to conduct the study from the University of KwaZulu-Natal Humanities and Social Science Research Ethics Committee. A gatekeeper's letter will also be sent to the researcher by the Durban Chamber of Business and Industry, as well as the participating SMEs. During the study, the participants' privacy, confidentiality, and anonymity will be safeguarded, and the information acquired will only be used for research reasons. Furthermore, because this is a voluntary participation, participants will have the freedom to exit the study at any time.

1.16 Limitations of the study

The following are some of the research study's potential limitations:

-Limited Resources

The study will take longer to complete, it will be impeded by a lack of resources.

- Online Platforms.

SME owners take longer to respond to phone interviews, and some do not respond at all, slowing the study's progress. The researcher will follow up on all invitations sent to SME owners.

-Covid-19 would limit Walk-ins

As the globe and South Africa are battling with the COVID 19 Pandemic, walk-ins to SMEs are not permitted because they risk contaminating and spreading the virus. As a result, the research will take longer to finish than it would under normal conditions.

In addition, there is a lack of representativeness, which will affect how insights are acquired in the target population.

1.17 CHAPTER OUTLINE

The Introduction chapter discussed the problem statement, study objectives, research question, study focus, and the study's significance. The Literature Review will be covered in Chapter two (the surveying of previous studies on Small and Medium Enterprises, the fourth industrial revolution and sustainability). And the conceptual framework. The research approach will be discussed in Chapter three together with the study's aims and objectives. Research Method: As soon as the researcher receives ethical clearance from the ethics committee to begin data collection, this part will focus on the ethical clearance application and collection of primary data from the study sample. Chapter four will concentrate on the presentation of the primary data acquired from the qualitative interviews. Furthermore, chapter five will be devoted to a discussion of the findings based on the data acquired from the telephone and video interviews. Finally, chapter six will discuss the study's conclusion, recommendations, limitations, and areas for future research.

1.18 CONCLUSION

This study chapter provided an outline of the study. Furthermore, this study will investigate the manner on which Durban SMEs have encountered challenges in being in the fourth industrial revolution and how SMEs can overcome hinderances of adopting collaborative robots. Furthermore, the usage and future prospects of adopting collaborative robots as part of SMEs manufacturing that will ensure they engage in sustainable entrepreneurship, thus reducing waste, taking care of the society they operate in while reaping economic returns. The study is targeting 20 SMEs that operate in Durban. In addition, the study will use the qualitative approach. The qualitative approach would enable the researcher to make an interpretation of what they see, hear and understand. Qualitative research method enables a thorough scrutiny of the researched topic. In addition, the study will use interviews as a research

instrument. The qualitative data gathered through interviews will be analyzed using thematic analysis to allow the researcher to focus on data in a number of ways and in detail, reporting the semantic meaning in the data and interrogating the hidden meanings, assumptions, and ideas that lie beneath the data set. The next chapter pertains in-depth literature about SMEs, industry 4.0 and sustainability.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

SME's (Small-to-Medium Enterprises) are often regarded as the economic backbone of all countries (Ghazilia, Sakundarini, Hanim, Abdul-Rashid, Ayub, Olugu, and Musa, 2015). SMEs produce jobs in a variety of geographic locations, employing over 70% of the workforce, including low-skilled employees, and offering possibilities for skill development (OECD, 2019). Additionally, SMEs, particularly on the African continent, play a critical role in alleviating poverty by providing goods and services at a fair cost (Muriithi, 2017). As a result, small and medium-sized businesses (SMEs) are important drivers of entrepreneurship and innovation. Small and medium businesses, according to Neagu (2016: 4), create many new products and processes, whereas large corporations tend to focus on existing products and improving them.

Based on the findings of (Berisha and Paul, 2015) point that there is no agreed upon way of defining SMEs. It all depends on the country, industry or sector, the number of employees, the assets and products, the business size among others (Muriithi, 2017). Despite the size of small and medium enterprises, they contribute to environmental sustainability in some way. On this regard, (Blundel, Monaghan, & Thomas, 2013) argue that focus has been directed on large firms on the compliance with environmental sustainability and less on Small and Medium Enterprises (SMEs). Furthermore, SMEs have an environmental impact accounting 60% on the production of waste. However, SMEs have disproportionate environmental impact on certain sectors (Blundel et al., 2013).

Moreover, waste generation dates back to the first industrial revolution that introduced the steam engine in the eighteenth century, to date the industrial revolutions have introduced advanced technologies with the aim of reducing waste (Blundel et al., 2013). Likewise, the fourth industrial revolution was introduced to enhance the performance of firms at the same time reducing waste (Pereira & Romero, 2017).

On a sustainability perspective, Reddy and Thompson (2015) asserted that sustainability is the efficient allocation and distribution of resources intra-generationally and inter-generationally over a certain period of time with the operation of economic activities in a finite ecosystem (Littig & Griebler, 2005), argued that sustainability is the connection between economic, environmental and social sustainability. However, the precise relationship between the three pillars of sustainability is unclear. Based on the ideas of Brown, Dillard & Marshall (2017) sustainability is a natural system that offers the context and sustains social systems therefore, it must be respected, nutured and sustained. Social systems provide the context and purpose of economic systems. In simpler terms, the economy is the basis and subset of society and the environment.

Developed nations such as Germany, America and China among others have adopted collaborative robots and the businesses have become sustainable, thus balancing the three capitals of sustainability for example, Ford in Germany deployed collaborative robots (cobots) in one of its plants or assembly lines where collaborative robots or cobots work alongside employees to execute complex task and thus to avoid repetitive tasks and achieve sustainability. The cobots ensure economic sustainability by producing more vehicles in a short time frame, Further to this, the cobots do not replace employees but works with them successfully (social sustainability) and thus using less harmful materials in the process (environmental sustainability), Ford is also seeking to introduce its cobots in its facilities in Spain, Valencia, Romania and Craiova (Spprovieri, 2019).

Similarly, this calls for the importance of Durban SMEs to adopt robots that will collaborate with humans which will enable SMEs operating in Durban to adopt a strategic approach to doing business which will ensure that they are sustainable in generating revenue, reducing environmental impact while taking care of society they operate on (Nahavandi, 2019; Simoens, 2019; Berawi, 2019).

Likewise, collaborative robots are robots that are aimed at working with humans on the workstation or factory floor to perform tasks and ultimately achieve sustainability goals (Nahavandi, 2019). The cooperation between humans and robots, will result in humans working fearlessly with robots knowing that the cobots (collaborative robots) fully comprehend them and have the ability to collaborate with them. As a result, this will lead to value added production process, trusted autonomy and reduced waste and costs. Likewise, the cobots will have the ability to learn, and know what to do. The cobots will be aware of the human presence and will therefore ensure safety and risks that emerge, the collaborative robots will notice, feel not only the human they are working with but the also the set goals and expectations of the human operator (Simoens, 2019).

As a result, this study will explore on the potential of the Human-Robot Collaboration and the manner on which Durban SMEs can adopt collaborative robots that will collaborate with humans which will ensure sustainable production, thus reducing waste, taking care of the society they operate in while reaping economic returns.

2.2 Defining Small and Medium Enterprises (SMEs)

There are numerous definitions that differ by nation and include factors like staff numbers, net assets, invested capital, and yearly turnover (Vaikunthavasan, Velnampy & Rajumesh, 2016). Similarly, Muriithi (2017) pointed out that defining SMEs varies from the use different indicators which include little money to start while others require millions, the number of staff, the annual turnover, and investments. Conversely, Muriithi (2017) argued that it is very difficult to arrive at a standard definition of SMEs. This claim was also supported by Ghatac (2013) who highlighted that there is no agreed upon

definition of SMEs. However, the most common criteria used to define SMEs at the international level include criteria such as the number of employees, the total assets, sales and investment level.

Small and Medium Enterprises (SMEs) are defined by Rhman, Alam, and Kar (2013) as businesses with fewer than 250 employees and annual revenues of less than 50 million Euros. Furthermore, SMEs vary in size, with some employing fewer than 50 people and turnover less than ten million euros per year. According to Vaikunthavasan et al. (2016), SMEs are defined as businesses with a total annual turnover of less than Rs 500 million and borrowing of less than Rs 200 million. Muriithi (2017) goes on and highlights that in America and Canada SMEs are enterprises that have less than 500 employed staff and small businesses are those that have less than 100 employees. Furthermore, In Germany small and medium enterprises have 250 employees, in Belgium SMEs have a limit of 100 employees. On the countries that are developing with Africa being included SMEs an enterprise that employs 100 staff is regarded as large whereas a small enterprise has one to five employees. Small and Medium Enterprises (SME) are defined in South Africa by the National Small Business Act of 1996, as cited by (Berisha & Pula, 2015), as enterprises with 21 to 50 employees for small businesses and 51 to 200 employees for medium businesses. Berisha & Pula (2015) further highlights that enterprises are defined using both qualitative and quantitative criteria. On a quantitative context SMEs are defined according to their number of staff, the annual work unit and their annual turnover. On the qualitative context SMEs are defined based on factors such as personal principle and the unit of leadership and capital.
As a result, this study describes SMEs as companies that preserve sales, assets or several personnel under a positive threshold. Furthermore, a small business is defined as business to have less employees ranging from twenty-one and fifty and medium enterprises to have employees ranging from fifty-one to two-hundred employees (National Credit Regulator, 2013). The applicable to SMEs according to this study is the number of staff, the technology the SME has adopted and the financial position.

2.3 The Integral Role Played by SMEs

Small and Medium Enterprises are playing a magnificent role in the local, national and international economies through the creation of jobs and income generation (Asgary, Ozdemir O¨ zyu¨rek, 2020). Small and Medium Enterprises account for about 40 to 60 percent of Gross Domestic Products (GDP) in both developed and developing countries and create a global industrial production accounting 40 percent and responsible for 35 percent of the global exports (Asgrary et al., 2020).

SMEs are important in the creation of new products and technological processes compared to large enterprises who focus more on improving existing products regardless of having a number of research departments, enabling them to produce in large volumes which is advantageous in a dimensional

economy. Further to that, SMEs are more flexible which allows them to adapt their products quicker to the changing market conditions (Neagu, 2016).

In addition to this, *"SME's integrate production components that would not be utilised in other circumstances, such as local resources or secondary products from large corporations. Partnership agreements (financially, technologically, and so on) or the nature of supply (capacity, speciality, and so on) demonstrate that SMEs collaborate with large corporations"* (Neagu, 2016: 335).

Venkatesh & Muthiah (2012) maintained that SMEs are typically started by a single or group of people primarily to make their living, flexibility in determining price and product in response to changes in market conditions, lower overheads leading to reduced costs of production up to a certain level, capable of meeting the niche market requirements and also of exporting their goods in small quantities, creating 80 percent of the jobs known as labour intensive compared to the larger counterparts, use local labour, situated in a fragmented area, and emerge as "clusters" for specific units.

2.4 Challenges facing SMEs

SMEs face a number of challenges which hinders their prominent roles they play in the various economies, job creation, poverty reduction among others (Kowo, Adenuga & Sabitu, 2019). The most pervasive challenge of SMEs in both developed and developing countries is the access to capital or finance. This pervasive challenge represents the constraints that negatively affect the ability of enterprises to grow, adopt advanced technology, expand to other market, enhance its management skills, optimise production and being able to compete effectively in the business environment (Ogundele & Olayemi, 2015). Similarly, the findings of Onyemere (2013) point out that the lack of financial support on SMEs is the primary inhibitor to SME growth and development. Moreover, the funds from the entrepreneur's personal savings and financial support from family, relatives and friends is not sufficient to access institutional finance capital market and banks.

2.4.1 Managerial competencies and skills

The performance of SMEs is heavily influenced by managerial skills. Small and Medium Enterprises, on the other hand, frequently fail due to a lack of managerial skills. Sitharam & Hoque (2016: 3) showed that small business owners or managers have very little understanding of the financial and accounting functions. As a result, poor strategic planning results from a lack of understanding of financial functions.

2.4.2 Technological capabilities

The ostensible reason SMEs encounter growth challenges is because of their inefficient technological capabilities and the access to technology, regardless of the fact that technology is advancing on the

global level, but it is cumbersome for SMEs in developing countries as there is a lack of technological implementation. As a result, SMEs in developing countries have an enormous challenge when they have to compete or grow (Sitharam & Hoque, 2016).

2.4.3 Regulatory factors

The primary constrain in the success of SMEs is the poor allocation of resources and over-regulation. The regulations pertaining the governing the establishment of SMEs which are intricate costly. Furthermore, SMEs do not comply to the regulations put in place because they are time consuming and too expensive. Moreover, SMEs do not understand the rules which govern them which makes it difficult to comply to those regulations. The set labour laws regulating businesses are rigid which are a constraint in business growth. Likewise, South Africa has the strictest labour laws which are also restrictive on the growth and development of SMEs (Sitharam & Hoque, 2016).

2.4.4 Crime and corruption

In comparison to wealthy countries, South Africa has one of the highest degrees of corruption. This is consistent with the results of Corruption Watch (2013), which demonstrate that South Africa has declined 34 places in Transparency International's (TI) 2013 annual global corruption perception index (CPI) since 2001. South Africa is ranked 72nd out of 175 nations. Furthermore, corruption is a significant impediment to SMEs' capacity to adapt and grow in South Africa (Xavier, Kelley, Kew, Herrington & Vorderwuibecke, 2012).

2.5 Environmental Sustainability

Environmental sustainability, according to Molthan-Hill (2017), is described as making decisions and doing actions in the interest of maintaining the natural environment, with a focus on preserving the ecosystem's ability to sustain human existence. Furthermore, environmental sustainability entails adopting appropriate decisions that allow firms to lessen their environmental effect. It is not concerned with the amount of waste produced by enterprises, but rather with implementing measures that would ensure the business's long-term viability. According to Sarango-Lalangui, Alvarez-Garcia, and del Ro-Rama (2018), environmental sustainability may be traced back to the Brundtland Commission's 1989 report, which was accepted by the United Nations General Assembly in 1987 and presented a suggestion to conserve the environment. Kopnina (2018), on the other hand, believes that "environmental sustainability often refers to difficulties linked with challenges ranging from climatic changes to species extinction to pollution."

In addition, Sarango-Lalangu et al. (2018) argued that different views and approaches are presented surrounding sustainability, however the Tipple-Bottom-Line is the underlying principle which underpins sustainability.

Williams & Schaefer (2013) argued that the involvement of SMEs in environmental sustainability is based on the internal locus of control of the owner-manager. The owner-manager´s personal drive also indicated how involved or engaged the business is to environmental sustainability. Hence, the main drivers of SME engagement with environmental sustainability stem from complying legislation, the stakeholders of the business putting pressure on the business, economic opportunities arising from environmental sustainability. Lastly, drivers also arise from competitiveness and ecologic pro-environmental behaviour.

2.6 Economic Sustainability

Economic sustainability is strongly linked with environmental as well as social issues.The limits to growth prove this. Reddy and Thomson (2015) argued that economies might not be sustainable if natural resources are used far beyond boundaries and if society will continue to rely on occurrences that have driven growth over the years, population growth combined with increased consumption of resources more than what the Environment can support can cause environmental, economic and social degradation or collapse. Consequently, the increasing risk of instability is also a challenge for the manufacturing sector with regard to the economic dimension of sustainability. A high degree of adaptability is important to be consistently competitive on the markets. However, the movement towards product individualisation must also be noted, which means shifting away from mass production to individual production with increasing diversity of product(s) (Abele & Reinhart, 2011).

Economic sustainability is entirely connected to social and environmental issues. Outcomes which a company earns. And while good financial and wider economic performance might mean short-term survival for businesses, it does not inherently ensure a long-term economic future, nor would it guarantee sustainable social or environmental outcomes. If the projections for sustainable development are right, failing to address the climate and social problems may be an obstacle to long-term survival both at the micro level or the macro level. As a result, those businesses that can handle their environment and the social effectively can also help make themselves economically sustainable (Doane and MacGillivray, 2001).

Furthermore, Industry 4.0 technologies will have an impact on several areas of the economy which will also be the main driver of innovation, economic growth, enhance productivity, competitiveness and sustainability (Pareira & Romero, 2017).

2.7 Social Sustainability

Social sustainability entails maintaining social capital. Investments and services that establish a fundamental foundation for society are social capital. It lowers the cost of working together and makes teamwork easier: trust reduces the cost of transactions. This can only be accomplished through systematic community engagement and a healthy civil society, including the government. Social mobility for mutual gain, link among people's organisations, mutual support, empathy, sympathy, perseverance, forbearance, friendship, Joy, generally accepted integrity, obedience and ethical values. Social sustainability is encouraged by widely shared guidelines, laws and knowledge (libraries, films and diskettes)

Furthermore, Sarango-Lalangui et al. (2018) posited that the social aspect involves good corporate governance in the society the businesses operate on, which integrates the needs of workers which wider society with the aim of doing business in an ethical manner and which takes care of the livelihood of the local communities. Consequently, on the social dimension demographic factors are a challenge where communities livelihoods are not enhanced by the enterprises operating in their community. Furthermore, as there are advancements in technology new skills are by employees in order to be able to perform their tasks and employers are expected to provide the relevant training to their staff. Therefore, the maintaining of health of workers and a conducive working environment essential now and in the future (Abele & Reinhart, 2011).

The work environment is rapidly changing due to enormous technological advancements that are taking place. The major change taking place is between humans and machines, which embraces the collaborative relationship between human beings and machines such as robots. The vision of Internet of Things (IoT) and Internet of Services (IoS) enables the creation of effective communication between smart machines and humans leading to the establishment of smart products that are environmentally sustainable and cooperation between employees in the work environment unemployment (Pareira & Romero, 2017).

2.8 The Industrial Revolutions

2.8.1 The first three industrial revolutions

The first industrial revolution introduced the steam engine and it took place in the middle of the eighteenth century, the second industrial revolution came into effect in the 19th century and it surrogated steam by chemical and electrical energy which were used to increase mass production. Furthermore, the third industrial revolution introduced electronics and computer technology to help automate production (Pareira and Romero, 2017). As a result of the employment of disruptive technical

advances such as the steam engine, power or electricity, and digital technology, the first three industrial revolutions had a massive influence on operations, allowing productivity and efficiency to grow (Dombrowski et al., 2017).

2.8.2 Introduction of the Advanced Technologies by the Fourth Industrial Revolution

The fourth industrial revolution, often known as Industry 4.0, is a build-up to the third. Industry 4.0 is a complicated technical system that has been widely debated and investigated, and it has had a significant impact on the industrial sector since it introduces vital improvements connected to smart and future factories. Similarly, Industry 4.0 is a new industrial age that encompasses a number of industrial advances such as Cyber-Physical Systems (CPS), the Internet of Service (IoS), the Internet of Things (IoT), Big data analytics, robots, and cloud-based manufacturing, among others (Pareira and Romero, 2017).

In addition, the fourth industrial revolution holds many possibilities and as provides social and economic possibilities by way of the paradigm shift pertaining working in organizations, creation of new business models and advanced production technology. However, industry 4.0 has not fully adapted but a new revolution has been introduced by industry pioneers and academics, this is the fifth industrial revolution which that is characterised by autonomous manufacturing and production with human intelligence within and on the loop (Nahavandi, 2019).

Business: A more effective and efficient communication channel between the various stakeholders of the business will be created and enhanced from factories, suppliers, distribution, customers or final buyers. Production costs, waste and resource utilization will be reduced. Therefore, the future of business will have an autonomous status and with a transmitted fast response rate (Qin *et al.*, 2016).

Products: A new version of products will be generated made possible by smart manufacturing. These types of products will carry information that will serve as a manual or guide to consumers on how to use the smart product, of which it will send feedback to the manufacturing firm as to how the customer perceives the benefits of the product (Qin, Liu & Grosvenor, 2016).

2.8.3 Collaborative Robots

Collaborative robots are robots that are aimed at working with humans on the workstation or factory floor to perform tasks and ultimately achieve sustainability goals (Nahavandi, 2019). The collaboration of people and robots will result in humans working freely with robots, knowing that the cobots (collaborative robots) completely perceive them and can interact with them. As a result, this will result in a more value-added manufacturing process, trusted autonomy, and decreased waste and expenses. Likewise, the cobots will have the ability to learn, and know what to do. The cobots will be aware of the human presence and will therefore ensure safety and risks that emerge, the collaborative robots will

notice, feel not only the human they are working with but the also the set goals and expectations of the human operator. Not only will humans learn how robots execute a task cobots will also watch and learn how the human operator performs a task and once they master the task, they will then operate the same task (Simoens, 2019).

In addition, on a production line the human operator will be working on an assembly of an electromechanical machine, the human operator will perform a task, while the robot will be observing what the human operator is doing using a camera on a gimba, the camera works like an of the robot. The robot is also connected on a computer that will be taking the image, process the image(s) then learn the patterns by the aid of machine learning. The collaborative robot will observe the human operator, monitor the environment and will infer what the human operator will do next using human intention analysis powered by deep learning. Furthermore, the cobots will use an essential sensor that will be used to understand the intention of the human operator is the functional-near infrared spectroscopy via a wireless communication channel to retrieve signals in the brain. This comes in a form of a headset and does not consume time being set up (a new form of artificial intelligence). Once the robot is confident enough about the prediction it will assist the human operator which will thus increase the overall efficiency and sustainability (Nahavandi, 2019; Simoens, 2019).

The collaboration between humans and robots will revolutionise the production and manufacturing across the world by removing dull, dirty, and redundant tasks from human operators where possible to achieve sustainability. Intelligent robots and systems will penetrate supply chains on an unprecedented level. The collaboration between people and robots on the production floor is about the complicated challenge of human and technology engagement with direct human connection in two separate modalities. First, there is physical cooperation, which occurs when humans and technology make explicit and purposeful touch with each other and exchange forces (robot). The robot can guess what the human's intention is and reply accordingly. Secondly, the contactless cooperation occurs when there is no physical engagement between a human and the robot on a manufacturing floor or at a workstation. In this situation, activities are coordinated based on information sharing, which may be performed by direct communication such as voice and gestures or indirect communication such as body language (through facial expression, eye gaze direction). Furthermore, the human operator performs activities that involve dexterity and/or decision making, whilst the robot detects unsuitable components and replaces them with another acceptable part in order to achieve sustainability(Hentout, Aouache, Akli, 2019). Moreover, safe operating systems on the factory floor will be ensured by reliability and trust between the intelligent robot and the human worker which will ensure flawless production, minimum waste and efficiency in pursuit of sustainability (Nahavandi, 2019).

2.9 Industry 4.0 Challenges faced by SMEs

2.9.1 Lack of resources

A study conducted by Onyemere (2013) pointed that the major impediment to SME growth and development is a lack of financial backing. It is commonly recognized that adopting modern technology might be more difficult for developing countries. As a result, the economies of emerging nations such as South Africa have historically been more focused on the extraction and marketing of commodities. Enterprises in these countries typically lag behind their counterparts in established countries in terms of technology adoption. (Ramani, Thutupalli, Urias (2017).

2.9.2 Lack of Information

Frank, Dalenogare, Ayala (2019) argued that since the concept of Industry 4.0 is still relatively new, there is a great deal of confusion and understanding regarding the true effect and contribution of Industry 4.0-related technologies in emerging nations in general. A new Calitz, Poisat and Cullen (2017) which pointed out the need for new skills and knowledge as there will be digitization of factories. These skills are complex problem solving, critical thinking, service orientation and quality control. Moreover, PWC (2017) argued that the fourth industrial revolution technologies, requires advanced skills and knowledge which are far beyond basic literacy, taking into consideration of the complex nature of the fourth industrial revolution.

2.9.3 COVID 19

The COVID 19 has had a significant impact on the global economy, particularly on business activities that have been hampered by lockdowns and other mobility restrictions. Economic recovery from the pandemic is expected to take a significant amount of time. COVID has had the greatest impact on various service sectors, including tourism and hospitality (Wut, Lee, Ip, Lee, 2021). Further to this, Lee et al. (2021) stated that the COVID 19 has had a significant impact on the global economy, particularly on business activities that have been hampered by lockdowns and other mobility restrictions. Economic recovery from the pandemic is expected to take a significant amount of time. COVID has had the greatest impact on various service sectors, including tourism and hospitality.

2.10 SMEs Overcoming Industry 4.0 challenges

The findings of OECD (2016) point that government should act like a good gardener, “preparing the ground” (increasing human resources), “fertilizing the soil” (increasing research and development),

"watering the plant" (increasing financial support for innovation), and "removing weeds and pests" (increasing financial support for innovation) (removing regulatory, institutional, or competitive obstacles to innovation). Given the severe trade and investment restrictions in comparison to other countries in the region and globally, removing weeds and pests is likely one duty that government has ignored the most (OECD 2016). Furthermore, in order to accelerate technology transfer and diffusion, barriers such as cumbersome policy and guidelines that raise the cost of doing business in the country must be removed as soon as possible (OECD, 2016).

In addition, Calitz, Poisat, & Cullen (2017, p.09) who pointed out that the importance of training and education in the introduction of Cobots has been emphasized. Companies benefit, technology understanding, and benefits are the most important training needs for the introduction of Cobots at the senior management level. 'Knowing what is present on the market, how it can create a competitive edge, and how it can benefit the organization are the primary problems for senior management, according to one responder. Greater technical training is required for the deployment of Cobots at the staff level Calitz, Poisat, & Cullen (2017, p. 09).

2.11 Sustainable Entrepreneurship and Industry 4.0

The success of businesses on industry 4.0 will depend on the ability of the managers to make innovative decisions as business fundamentals have drifted towards innovation and efficiency as the key drivers of growth and business success. The collaboration of technology (robotics) and humans will enable sustainable entrepreneurship to be geared towards the implementation of green strategies and techniques that are more efficient in the reduction of waste. Likewise, the sustainable entrepreneurship processes will be designed in such a way that they have a low environmental impact. Lastly, sustainable entrepreneurship in industry 4.0 will adopt new business models that will prevent pollution, reduce the usage of non-renewable energy sources, the manufacturing and production of goods that are eco-friendly, and the redesigning of business of products and processes (Ghazilia, Sakundarini, Hanim, Abdul-Rashid, Ayub, Olugu, and Musa, 2015).

Furthermore, the SMEs will have an opportunity to decrease their expenditures in the medium to long term which is a crucial point in the business case for sustainability. Making the companies more energy efficient would save entrepreneurs and owner managers a large quantity of energy costs and help them increase their bottom line. Conducting a cost-benefit analysis would enable them to assess the advantages of environmentally sound processes with the potential cost of implementation (Ghazilia et al., 2015).

In addition, environmentally sound companies can also have a strategic edge when it comes to attracting consumers and investors. Modern customers are aware of social and environmental concerns and keep themselves updated about which companies in the society behave responsibly. Investors are equally

conscious of these concerns and the shift towards engaging in environmentally friendly businesses is increasing (Tsarouchi, Spiliotopoulos, Michalos, Koukas, Athanasatos, Makris and Chryssolouris, 2016).

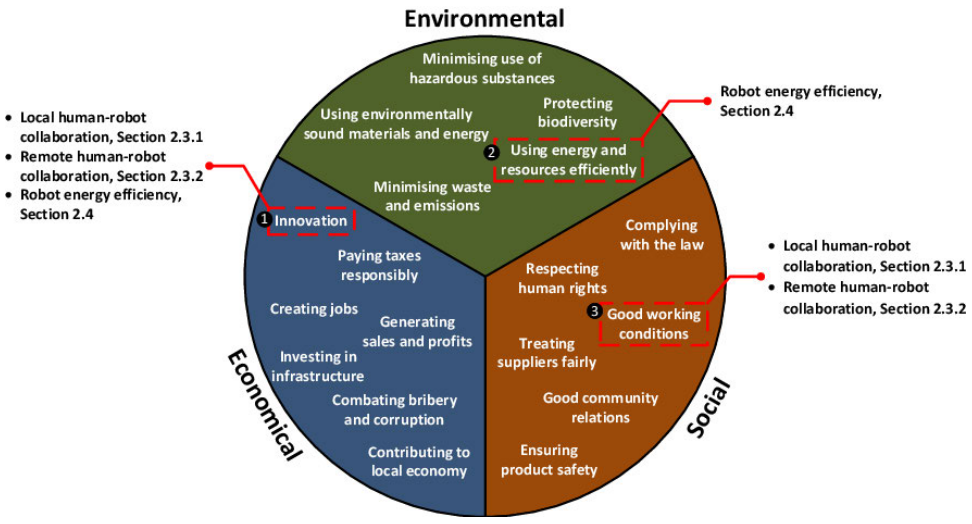
Likewise, the most important point in considering the business case for sustainability is that it does not have a negative impact on the business' ability to generate profits. In fact, in the long run, it is perceived to significantly improve revenue and profits by reducing costs and increasing competitive advantage (Tsarouchi et al., 2016).

Moreover, changing consumer preferences is the key factor of sustainability differentiation. Customers are becoming more mindful of and interested in limiting their negative impact on the environment. Customers are also publicly expressing their anger at companies that concentrate on making money at the cost of a safe community. Enterprises have taken the opportunity to distinguish themselves on the basis of their contribution to environmental sustainability (Tsarouchi et al., 2016).

As a result, a variety of advantages can be achieved by SMEs strategically promoting their enterprises, goods and services. Importantly, the fact that environmentally harmful companies are cutting themselves off from the community of consumers who only purchase sustainable goods must be taken into account. Sustainable companies, however, are available to all customers, regardless of the value they put on the sustainability of the environment. (Tsarouchi et al., 2016).

2.12 Theoretical Framework

A theoretical framework serves as a guide and as a blueprint that supports the study (Sekaran & Bougie, 2016). According to Adom, Hussein & Agyem (2018) a theoretical framework is a blueprint that is adopted by the researcher to build the study´s research inquiry. Furthermore, a theoretical framework serves as a foundation upon which the study will be constructed. As a result, this study proposes to adopt the human-robot-collaboration framework.



2.12.1 Figure showing the human-robot collaboration maintaining sustainability
Adapted from (Alkhdur, 2017).

Human-Robot-Collaboration Framework

According to Tsarouchia, Spiliotopoulosa, Michalosa, Koukasa, Athanasatosa, Makrisa, and Chryssolouris (2016: 01), "Human-Robot-Collaboration is viewed positively by today's production firms, because it inspires them to maintain a favorable production cost, through the combination of both human skills and robot capabilities." Similarly, the Human-Robot-Collaboration concept examines how people and robots collaborate in the workplace or on the manufacturing floor to achieve common sustainability goals (Fetcher, Foith-Forster, Pfeiffer, and Bauernhansl, 2016; Tsarouchia et al., 2016; Tsarouchia et al., 2016).

Furthermore, industrial robots have long been developed to support human employees by providing a speedy and automated assembly method as well as a collaborative manufacturing environment. Different robot and gripper architectures have been created to aid employees on the assembly line (Wang, Wand & Vancza, 2017). Almost all of the tasks included holding an object for the user, putting it away, or retrieving it when needed. In recent years, the production engineering community has taken a keen interest in collaborative arrangements in assembly lines. Connections between humans and machines, as well as between humans and robots, have been regarded as a suitable method for handling large and bulky components while also ensuring sustainability (Wang et al., 2017 Mikus, Gotse & Schildt, 2014).

According to Mikus et al. (2014), there are many types of Human-Robot partnerships, which varies depending on the role and working environment. The first is stand-alone operation, in which the human and the robot operate on the same workstation but on separate areas of the workstation. Second, the synchronized operation, in which the human and robot are described as staggered, despite the fact that they are coordinated and have no geographical separation. Third, the collaborative operation, which is defined as the most intense since the robot and human are in touch, allowing for direct human-robot collaboration. As a result, these varied collaborative robots will help businesses to minimize waste, which has a negative influence on the environment, while also generating profit.

Furthermore, Wang et al. (2014) discovered that human-robot collaboration would result in sustainable manufacturing that considers the three aspects of sustainability and so ensures long-term economic growth, environmental preservation, and social responsibility. As a result, on an economic level, operations that were previously difficult to automate, such as complicated processes, will now be automated to a greater extent, increasing productivity and efficiency while cutting costs of production.

On an environmental aspect, collaborative robots will cut waste by reducing the number of repetitive tasks that humans execute. Overproduction and flaws will be reduced using robotics (where products are manufactured or produced with faults and thus, they become waste). Inventory waste, which includes leftover raw materials, work-in-progress, and finished commodities that have no value. Furthermore, robotics will prevent items from being processed above the needed threshold in order to satisfy client wants or requests (Smock, 2018). Finally, the Human-Robot Collaboration will relieve human employees of monotonous or regular activities, ensuring a pleasant working atmosphere. As a result, high-performing personnel will be able to counteract demographic shifts (Mikus et al., 2014).

As the study is about current advanced technology associated with the fourth industrial revolution, the human and technology (robot) framework is best suited for the investigation. Furthermore, unlike previous frameworks, the framework effectively addresses how humans will collaborate with technology (robots).

2.13 Conclusion

SMEs play an integral role in the South African economy through their manufacturing and production of goods and services and seen as distinguished drivers of change when it comes to technology and innovation. Furthermore, SMEs play an essential role for creating opportunities both economically and socially.

Given these points, SMEs also have a huge role to play pertaining the three pillars of sustainability. Therefore, SMEs have an obligation to protect the well-being of the environment where they operate on, that will ensure that the environment is in a good state the resources are not depleted but conserved for both the present generation and generations more to come, the social well-being of its employees and society, while reaping on economic sustainability. As a matter of fact, the Human-Robot Collaboration Framework has the potential of SMEs being sustainable, through the adoption robots that will collaborate with humans which will enable SMEs to adopt a strategic approach to doing business which will ensure that they are sustainable in generating revenue, reducing environmental impact while taking care of society they operate on. The next chapter to follow, which is chapter three will present the research methodology, giving an outlay of the methods used and the justifications for the chosen methods.

CHAPTER THREE: RESEARCH METHODOLOGY

3. Introduction

The research procedure will be the subject of this chapter. It will provide information on the approach that will be used to conduct the research. The steps of the research are described in this chapter, which include the research design, research methodology, study site, study population, sampling methodologies, data collection tools, data administration, and data analysis methods. Finally, the chapter concludes with a review of quantitative research validity and reliability, as well as how the latter were preserved in the study.

3.1. Research Methodology

The systematic approaches that will be used in research are referred to as research methodology. Rajasekar (2013), referenced in (Almalki 2016: 290), defines research technique as the procedures that researchers take to foresee, explain, and predict phenomena. A research technique is used to guide the study's execution. The research technique helps the researcher to instill the capacity to assess research findings and offer a thorough understanding of the issue (Igwenagu, 2016). Furthermore, the research methods portion is the one that requires the most attention to detail (Gray, 2019). The research methodology includes the research design, research technique, study site, population, inclusion and exclusion criteria, sampling design, sample, and sample size.

3.1.1 Research Design

A research design specifies the steps that must be followed in order to solve the research problem (Sekaran and Bougie, 2016). It acts as a blueprint or strategy plan as to how data will be gathered and analyzed (Dannels, 2018). Action research, case study, ethnography, experiment, and grounded theory are examples of research designs (Sileyew, 2019).

Action research is a research method or approach that tries to effect intended changes. It is a study design element that identifies a problem and aims to propose answers to the recognized problem (Sekaran and Bougie, 2016; Igwenagu, 2016). Ethnography is a method of studying the lives of people from various cultures by attentively observing them and asking questions in order to have a better understanding of them (Leavy, 2017). Furthermore, an experiment is a type of research study that examines the relationship between variables. A researcher manipulates the independent variable in an experiment to see how it affects the dependent variable. On the other hand, survey research is a way of gathering data from or about individuals in order to characterize, identify, and categorize their knowledge, attitudes, and/or behavior.

As a result, among the various types of research designs, case studies will be used in this study. A case study is a type of research study that focuses on gathering data on a specific topic. In case studies, the topic is tackled from numerous aspects utilizing diverse data gathering methods in order to obtain in-depth knowledge on the subject or problem (Cresswell and Poth, 2016). Case studies will be used in this study because they will allow the researcher to get a comprehensive, multi-faceted comprehension of the complicated issue at hand (exploration of the Human-Robot Collaboration Framework potential for sustainability on Durban SMEs).

3.2. Research Approach

In its most basic form, research refers to the activity of seeking information and truth (Sekaran and Bougie, 2014). Formally, research is a scientific study of a problem approached through a purposely selected approach that begins with selecting a technique and ends with offering answer/s to the research problem. This includes designing research hypotheses, selecting methods and strategies, selecting or developing data collection tools, processing the information, interpretation, and ending with offering answer/s to the research problem (Grover, 2015:1). Furthermore, it will depend on the strategy chosen by the researcher, the solutions to the problem may differ in scope which could be generalized over person, sample or a population.

Research means the plans and course of action for research that encompass steps from comprehensive presumptions to detailed data collection methods, analysis and interpretation of data (Almalki, 2016). The entire decision involves the research approach to be used to study a topic. Reaching this decision is guided by philosophical assumption the approach will bring into the study, research design, data collection methods analysis and interpretation being guided by the design. The research approaches are the qualitative approach, the quantitative approach and the mixed methods approach.

3.2.1. The Qualitative Approach

According to Sekaran and Bougie (2016), data in the form of words is a qualitative research technique (s). However, defining qualitative research, according to Ritchie, Lewis, Nicholson, and Ormston (2013), is difficult. On the other hand, qualitative research, according to (Zikmund, Barbin, Carr, and Griffinn, 2013), relate to the predominance of qualities of things and courses of activity that are not evaluated or assessed empirically. According to McCusker and Gunaydin (2015), qualitative techniques are used to answer questions like what, how, and why a phenomenon occurs rather than how much or how many, which are answered by quantitative approaches. Furthermore, the researcher plays an essential role since the data will be interpreted by the researcher after its acquisition. Rovai (2014) on the other hand argues that the qualitative approach is usually *''the basic assumptions are that reality is*

a social construct, variables are difficult to measure, complicated and interwoven, subject matter is paramount, and the data obtained will reflect an insider's perspective".

3.2.2 The Quantitative Approach

Quantitative methods to research are deductive. Furthermore, quantitative researchers perceive the universe as being outside of themselves, and that there is an objective reality that exists independently of those or any observations (Rovai, Baker & Ponton, 2014). In addition, quantitative studies may be viewed as a scientific research of a phenomena via accumulating data that is quantifiable. The outcomes of those samplings can be statistical in nature. Quantitative methods are also investigational in nature. Rovaie, et al. (2014) defined quantitative research as research that employs a deductive approach to research. Furthermore, the quantitative approach is typified by the researcher using a theory, exemplified by a hypothesis that is tested, from which conclusions can be drawn after a series of observations and analyses (Rovai et al., 2014; Grover, 2015). When using a quantitative technique, the researcher's honesty is more important, which suggests that the quality of the raw data is critical. If the data is of poor quality, the statistical computations will be poor as well (McCusker and Gunaydin 2015).

3.2.3 The Mixed Methods Approach

According to Almalki (2015:3), the mixed methods approach is defined in a number of ways, making it a difficult idea to grasp. This is a method of research that incorporates both quantitative and qualitative data into a single or series of investigations (Sekaran and Bougie, 2016; Almalki, 2016). The mixed methods approach is appealing because it provides solutions to issues that quantitative and qualitative investigations are unable to provide (Cresswell, 2016). Almalki (2015) agrees with Cresswell's observation that a mixed technique approach allows for a greater level of comprehension than a single strategy. Likewise, the mixed methods approach allows the researcher to integrate both deductive and inductive thinking to use more than one approach to solve the problem and to tackle the problem with various kinds of data (Almalki, 2016; Grover, 2015).

The different types of mixed methods

The various scholars have debated about the exact number of the different types of mixed method designs. On the other hand, Doyle, Brady and Byrne (2013: 05) highlighted that choosing the type of mixed method design is a complex and controversial task. However, the main advantage of the mixed methods is to form rigor and guidance on the execution of the chosen mixed method typology.

Sequential explanatory design

This form of mixed method design is employed when the researcher gathers and analyzes quantitative data before moving on to qualitative data gathering and analysis. During the study's interpretation step, the quantitative data is prioritized, and the findings are merged (Cameron, 2015; Doyle et al., 2013).

Sequential exploratory design

This is a type of mixed methods design in which qualitative data is collected and analyzed first, then quantitative data is collected and analyzed (Doyle et al., 2013). The qualitative aspect of the study is prioritized, and the findings are integrated during the study's interpretation stage (Cameron, 2015).

Concurrent triangulation

This is a sort of mixed methods study in which just one data collection phase is employed, and quantitative and qualitative data collection and analysis are done independently and simultaneously. During the study's interpretation step, the findings are combined, and both methodologies are given equal weight (Cameron, 2015; Doyle et al., 2013).

Concurrent nested

This is a sort of mixed methods design in which the dominating technique (qualitative or quantitative) nests or embeds the less important methods throughout the data gathering phase (quantitative or qualitative) During the analysis step, the data from both approaches is combined (Cameron, 2015).

From the three research approaches this study will adopt the qualitative approach primarily because the qualitative approach will enable the researcher to make an interpretation of what they see, hear and understand. Qualitative research method enables a thorough scrutiny of the researched topic which is not possible in quantitative research. Furthermore, the researcher is provided with a vast range of options and opportunities for exploring diverse issues within the area of organizational research.

3.4 Study site

The geographical location where the study will be performed is referred to as the study site (Sekaran and Bougie, 2014). The research was carried out in KwaZulu-Natal, namely in the city of Durban, where the target population of SMEs was found. The researcher chose Durban as the study site because SMEs in Durban face a challenge in balancing the three capitals of sustainability; additionally, the Human-Robot Collaboration Framework has the potential to ensure that SMEs in Durban are sustainable, reducing waste and caring for the society in which they operate while reaping economic returns.

3.5 Target Population

A target population, according to Alvi (2016), is defined as those who satisfy the study's requirements. Small to medium companies (SMEs) operating in Durban are the study's target group.

The Durban Business Chamber, which contains a data base of 667 433 official enterprises in Durban, will be used to extract the target demographic for this research study.

Small to Medium Enterprises (SMEs) with a turnover of zero to fifty million rand will be included. These SMEs could be in any sector or in major sectors such as agriculture, manufacturing, automotive, education, and construction, among others, which have a large number of stakeholders and a visible impact. The sample size is sufficient to adequately characterize the phenomena of interest and answer the research questions at hand.

3.6 Sampling Strategies

Sampling is the process of picking the most representative individuals, objects, or events from a population (Sekaran and Bougie, 2016). The obvious rationale for employing a sample rather than gathering data or information from the full population is that doing research, collecting data, examining, or testing each and every member of a population with hundreds or even thousands of elements would be impracticable. Even if it were conceivable, the time, expense, and human resources required would make it prohibitive. Similarly, Alvi (2016) claims that researching a sample rather than the full population yields credible results, and that the findings are generalizable if they are representative or true for the entire population. The two forms of sampling are probability sampling and non-probability sampling.

When the individuals in the sample have a known chance of getting picked, it's called probability sampling (Sekaran and Bougie, 2016). Probability sampling is divided into two types: simple random sampling and sophisticated random sampling.

3.6.1 Unrestricted or Simple random sample

This is a sort of probability sampling in which each subject has a known and equal chance of being chosen for the sample. Furthermore, each topic should have a listable or mappable element, be mutually exclusive, and be homogenous (Alvi, 2016).

3.6.2 Restricted or complex probability sampling

Sekaran and Bougie (2016) argue that restricted or complex probability sampling is more viable and efficient compared to the unrestricted random sampling. Furthermore, there is improved efficiency, and

more information can be obtained. The complex probability designs include systematic sampling, stratified random sampling, cluster sampling, area sampling, and double sampling.

In brief systematic sampling This is a sampling design whereby every nth element in the population is drawn and starting with randomly selected elements between 1 and n (denote an unspecified part of a number sequence or objects enumerated) Stratified random sample implies stratifying or segregating then the process of stratifying each element from each strata (Sekaran and Bougie, 2016; Taherdoost, 2016). Furthermore, Taderhoost (2016:21) asserts that cluster sampling design is used when the population is distributed on a sizeable geographical region. The samples of the population are gathered in the form of groups or portions of elements that theoretically are aggregates of the elements in the population. Double sampling on the other hand is whereby a sample is used to collect information then preliminary information is recollected so the samples provide more information or insights in the problem under investigation (Sekaran and Bougie, 2014).

3.6.3. Non-probability sampling

The items in non-probability sampling have no known or predefined likelihood of being picked into the sample (Sekaran and Bougie, 2016). Non-probability sampling is employed when the sample's representations are extremely important in terms of generalizability (Sharma, 2017). Convenience sampling and purposive sampling are examples of convenience sampling designs (judgement sampling and quota sampling)

In a nutshell, convenience sampling This is a type of non-probability sampling in which the researcher selects those individuals who are simpler to contact. (Elfil & Negida, 2017; Tarhedoost, 2016). Second, purposive sampling is a type of non-probability sampling in which information is acquired from participants who fit the study's or the researcher's requirements rather than from the available subjects. Finally, judgement sampling is a type of purposive sampling in which people who are in a good position to supply the information are chosen. Therefore, purposive sampling is used when there are limited subjects who possess the required information (Sharma, 2017). Lastly, quota sampling design is used when the subjects or target groups are heterogeneous and that the target groups are sufficiently represented in the sample through the assignment of a quota (Farhedoost, 2016).

This study will use non-probability (convenience sampling) sampling because the participants of the study will be easy to reach out using online questionnaires and in the presence of the COVID 19 Pandemic which limits the distribution of questionnaire s face-to-face, online communication is the amicable alternative, hence the study chose convenient sampling.

3.7. Sample size

A sample size is the number of people or experimental units included on a research study and are representative of the real population of the actual study. Sekaran and Bougie (2016) argue that a sample size is regulated by the level of precision and confidence. Likewise, the study´s sample size was determined by the extent of precision and the confidence level.

The sample size of this research paper was extracted from the target population of 667 433 formal businesses located in Durban. The researcher targeted to conduct a sample of 20 virtual interviews (where saturation will be reached on the qualitative study). The qualitative sample size was large enough to sufficiently address the phenomenon of interest and address the research questions at hand. As described by (Saunder, Sim, Kingstone, Baker, Waterfield, Bartlam, Burroughs and Jinks (2018) that data that has already been acquired tends to be redundant in new data. Data saturation is obtained in interviews when the researcher hears the same statements over and over. Then it's time to stop gathering data and begin analyzing it. In addition, saturation occurs not at the level of the entire dataset, but rather in respect to the data supplied by a single participant; in other words, it occurs at a specific time inside a singular interview. Probing should continue until the researcher thinks they have a complete knowledge of the participant's point of view (Hill, Baird, Walters and Quality, 2014; Jackson, Harrison, Swinburn, Lawrence, 2015; Middlemiss, Lloyd-Williams, Laird, Fallon, 2015).

3.7.1 Sample

A sample is a subset of a population that is chosen at random for research or study purposes. Furthermore, a sample is considered representative when the characteristics of the selected elements match those of the complete target population (Alvi, 2016).

3.8. Data collection methods

The process of gathering data or information from relevant sources with the goal of discovering solutions to the research problem is referred to as data collection methods (Ingwenagu, 2016). There are two types of data gathering methods: primary data and secondary data.

3.8.1 Primary data

Primary data is information that the researcher collects for the first time. There are two types of primary data: quantitative data and qualitative data. Figures are used as the basis for quantitative data collecting methods. Questionnaires are useful for gathering quantitative primary data (Sileyew, 2019).

3.8.1.1 Quantitative Primary data collection methods

3.8.1.1.1 Questionnaires

A questionnaire is method of data collection whereby the participants record their answers usually within closely defined options (Sekaran and Bougie, 2016). Furthermore, a questionnaire was propounded by Sir Francis Galtan (1822-1911), as a research instrument which comprises of a number of a series of questions with the aim of obtaining information from participants or respondents (Kabir, 22016). Questionnaires are designed to collect large amounts of data, questionnaires can be administered personally, can be distributed electronically and can be emailed to the participants.

3.8.1.1.2 Personally, Administered questionnaires

The personally administered questionnaires are ways of collecting quantitative data when the survey is carried out in a local area. The primary advantage of the personally administered questionnaires is that the researcher can distribute and collect the completed questionnaires within a short period of time without any hassles. Furthermore, the researcher can introduce the topic and clarify points where the participants do not understand. In addition, personally administered questionnaires are less time consuming as they can be distributed to a large number of people simultaneously and does not require complex skills. However, the drawback of personally administered questionnaires is that they may introduce bias as the researcher may explain the questions differently on different participants (Osand, Udoimuk, Etta, Ushie and Offiong, 2013).

3.8.1.1.3 Mail questionnaires

Mail questionnaires are self-administered with pen and pencil and are sent to the participants via the mail. The mail questionnaire method has been regarded as he backbone of business research, however mail questionnaires have been used less often lately due to the arrival of the internet (Sekaran and Bougie, 2016; Osand et al., 2013).

3.8.1.1.4 Electronic and online questionnaires

These are questionnaires that are posted online or sent via email. The electronic and online questionnaires are regarded as being fast and easy, all the researcher has to do is to email the subjects for an invitation to complete the questionnaire, post a link on the website or a blog and or use social media to send invitations to complete the questionnaire (Osand et al., 2013). This study will use the electronic and online questionnaires because they are fast and easy. Further to this, the electronic and online questionnaires will be more convenient due to the global COVID 19 pandemic which makes it

unsafe for the researcher to collect data face-to-face on participants which may ultimately result in the contamination of the virus.

3.8.2 Qualitative Primary Data Collection Methods

Qualitative data on the hand is not based on figures, it is presented in the form of words, audios, feelings, and non-quantifiable elements. Qualitative studies strive to get a deep or in-depth level of understanding. Qualitative data can be collected using interviews, focus groups, questionnaires and case studies among others (Sekaran and Bougie, 2014).

3.8.2.1 Interviews

Sekaran and Bougie (2016:113) describes an interview as a guided and purposeful conversation between two or more people. Brick and Green (2019) defined an interview as a day-to-day dialogue which are more or less focused on the researchers need for information. In addition, interviews are conducted in a rigorous way which makes them unique from the actual day-to-day discussions and are aimed to ensuring a high level of reliability and validity (Sekaran and Bougie, 2016).

Structured Interviews

This is a type of interview whereby the researcher asks the participant a similar set of questions. Sekaran and Bougie (2014) pointed that structured interviews are conducted when it is known that the outset the kind of information or data needed. The content of structured interviews is prepared in advance and consists of the following. Firstly, the interviewer introduces himself or herself to the participant and questions are formed prior to the interview. In addition, the questioning of the interviews is standardised and kept consistent from one interview to the next. Moreover, the interviewer plays a neutral role and does not add his or her opinions or point of views about the topic (Kabir, 2016).

Semi-Structured Interviews

These types of interview are more open compared to structured interviews, this allows both the researcher and the respondent to divert when the topic of discussion is is discussed in-depth. Moreover, semi-structured interviews allow the researcher to proceed with general outline of themes that can also

be expanded where necessary. Lastly, the questions can be asked in various ways with the aim of getting the same outcome or information (Sekaran and Bougie, 2016).

Unstructured Interviews

This is a form of interviews on which the interviewer enters the interview setting with no sequence of planned interview questions to ask the participant (Sekaran and Bougie, 2016). Furthermore, the possible objective of an unstructured interview is to bring some preliminary concerns to the surface so that the interviewer can determine which factors need more in-depth investigation (Sekaran and Bougie, 2014).

3.8.2.2. Focus groups

Focus groups are a form of an interview, with the difference in that on focus groups there is a moderator who facilitates the interview process. Furthermore, focus groups are used to gather in-depth information about subjects' perceptions, attitudes and beliefs pertaining a particular topic of interest (Then, Rankin, and Ali, 2014).

3.8.2.3. Observation

An observation refers to the planned watching, recording, analysis, interpretation of behaviour by the researcher. Observation is a technique used to collect data about people, processes and cultures in social science. As a matter of fact, observation is the hallmark of research and a method used in everyday social life (Ciesielska, Bostrom, and Ohlander, 2018).

From the different qualitative data collection methods, the study used virtual interviews (telephonic and video interviews). Virtual interviews are the interviews that are not conducted in person but are conducted virtually. Telephonic interviews full under virtual interviews. The study made use of telephonic and video interviews conducted through Microsoft Teams, zoom and telephone. This is a type of interview that is held over the telephone (brick and Green, 2019). The study used telephonic and video interviews primarily because they enable the researcher to interview respondents covering a large geographic region in a short time period and to avoid contact amid the COVID 19 outbreak. Furthermore, the respondent(s) may feel comfortable since some are uncomfortable with face-to-face interview.

3.8.3 Secondary data

Secondary data refers to qualitative or quantitative data that has already been collected in the past by other researchers, and is present in books, journals newspapers among others (Ibrahim and Tate, 2016; Johnston, 2014). Secondary may be accessed free by the researcher(s) or may first ask for permission from the authors or pay a fee to access the data. The use of secondary data reduces bias that is introduced in case studies and the intrusiveness of data collected in experiential methods such as interviews, action research and or experiments (Ibrahim and Tate, 2016).

The beauty of using secondary data is that secondary data is easily accessible and can be easily accessed. Secondary data reduces the usage of resources such as money and saves time. On the contrary, secondary data cannot always be available for all phenomena or research problems (Kabir, 2016).

3.9 Data quality control

3.9.1 Piloting

Van Teijlingen and Hundley (2014) describes a pilot study as the mini version of the actual study to test a particular research instrument such as a questionnaire or interview. A pilot study is also called a feasibility study. In addition, a pilot study is an essential element to a good research study. Despite the conducting of a pilot study it does not always guarantee that the study will be successful. The beauty of a research study is that it can give an early warning of where the research study could fail. Pilot studies are conducted on both quantitative and qualitative studies. Majid, Othman, Mohamad, Lim and Yusof (2017) pointed that piloting the interviews will look for any flaws or limitations there could be on the interview questions or design and enable major modifications on the study. Furthermore, Harding (2013) also asserted that it is important to pilot the interview questions before embarking on the major study and piloting also assists the researcher to maintain consistency in the conducting of interviews.

The researcher together with body representing SMEs piloted the questionnaires, the researcher administered the questionnaire to pilot subjects in exactly the same way as it was administered in the main study, the researcher asked the subjects for feedback to identify ambiguities and difficult questions, record the time taken to complete the questionnaire and decide whether it is reasonable, discard all unnecessary, difficult or ambiguous questions, assess whether each question gave an adequate range of responses, establish that replies can be interpreted in terms of the information that is required, checked that all questions were answered, re-worded or re-scaled any questions that were not answered as expected.

3.9.2 Trustworthiness of qualitative data

According to Gunawan (2015), trustworthiness in qualitative investigations should be related to truth or value, which are the same as positivists'. Furthermore, according to Gunawan (2015), a study is only reliable if the reader of the research report believes it is. Credibility, which is connected to internal validity, dependability, which is related to reliability, transferability, which is a sort of external validity, and finally confirmability, which is a presentation issue, are all subsets of trustworthiness.

3.9.2.1 Dependability

Moon, Brewer, Januchowski-Hartley, Adams and Blackman (2016) pointed that dependability indicates the accuracy and reliability of the study results and the extent to which research methods are reported, which allows those outside of the study to observe, inspect and critique the research process. As a measure of quality, dependability is highly pertinent for applications in environmental and preservation sciences that are in the initial stages of evaluating research results in various settings to boost confidence in the evidence (Adams et al 2014). Comprehensive coverage of the methodological approach used enables the reader to evaluate to what degree were relevant research practices were followed

3.9.2.2 Credibility

Credibility refers to the extent to which research provides the true interpretations of the research participants, or the "overall meaning". Furthermore, credibility derives from the intentional purposes of research when assessing qualitative research, and credible research decisions are consistent with the objectives of the researcher, calling on researchers and practitioners when judging methodology, to think critically and contextually decision making (Moon et al., 2016).

Credibility can be shown in strategies such as member checking returning findings to participants to ascertain whether the findings reflect their perspectives Both credibility and reliability conform to all components of a research design, such as research focus, context, selection of respondents, data collection as well as the amount of data obtained, all which affect how appropriately research questions can be answered (Moon et al., 2016).

3.9.2.3 Conformability

Investigators must show that the findings are explicitly related to the assumptions in a way that can be observed and repeated as a method to attain confirmability. Its application relevance is similar to credibility where confirmability has important consequences for studies that provide policy

recommendations. The philosophical and epistemological position of Qualitative research the problem and the predisposition of the researcher will be decided, in terms of the way they categorize "facts,". The researcher will also disclose on the measures that have been taken to control and report on the consequences of their theoretical or observational interests and, where applicable. Lastly, by presenting a comprehensive methodological overview, the researcher helps the reader to assess confirmability and to demonstrate how the data and assumptions that arise through it can really be accepted (Moon et al., 2016).

3.9.2.4 Transferability

Transferability, a form of external validity, relates to how relevant or useful the phenomenon or results mentioned through one study are to theory, practice and areas for further research. Transferability of findings of the study to several other contexts. Transferability can be crucial to the implementation of research results, since policy and management can rely on the information, recommendations and conclusions from a single or small number of research initiatives, sometimes dependent on scientific proof from a variety of contexts that may vary from that in which implementations are made. Therefore, it is important that researchers explain explicitly to what degree the results may or may not be applicable to other contexts. Likewise, the qualitative research methods and review need to explain why the study can clearly be (transferred) linked to the initial assertion (Moon et al., 2016).

To ensure that the study (interviews) is reliable the study will ensure credibility by testing what the study intends to test, ensure that the study is transferable to other settings, the findings will be reported in detail to enable a future researcher to evaluate or repeat the work in order to gain the same dependable results and lastly, the findings will be confirmed to demonstrate that they are experiences and ideas of the informants.

3.10. Data Analysis

Data analysis is a method of analyzing, cleaning, revising, and modeling data in order to uncover relevant facts, draw conclusions, and aid decision-making (Sekaran and Bougie, 2014). Thematic or content analysis is used to study qualitative data. Thematic analysis is the process of systematically detecting, organizing, and revealing patterns of meaning (Braun and Clarke, 2012). The researcher can make sense of communal or shared ideas and experiences by using thematic analysis. Material analysis (Roller, 2019:1) is defined as the systematic reduction of content studied with specific attention to the context in which it was formed, in order to uncover patterns that emerge from the data set and extract meaningful interpretations of the data (Roller, 2019:1).

On the other hand, quantitative data is analyzed using descriptive or inferential statistics. Descriptive statistics is mainly concerned with what is displayed on graphs, with the goal of reducing enormous

volumes of data to a manageable size. Inferential statistics is concerned with deriving inferences from a collection of data (Sharma, 2019).

The qualitative data was coded using the most recent version of NVIVO, which is version 12. NVIVO is a QSR International qualitative data analysis program that analyzes and draws conclusions from unstructured qualitative data such as open-ended surveys, interviews, and journal articles, among other sources (Sekaran and Bougie, 2016). As a result, thematic analysis was used in this study since it is versatile and allowed the researcher to focus on data in a number of ways and in detail, reporting the semantic meaning in the data and interrogating the hidden meanings, assumptions, and ideas that lie beneath the data set.

3.11. Ethical Consideration

The researcher adhered to ethical considerations by getting ethical clearance from the University of KwaZulu-Natal Humanities and Social Science Research Ethics Committee, which granted the researcher permission to conduct the study. In addition, the Durban Chamber of Business and Industry, as well as the participating SMEs, were sent the gatekeeper's letter by the researcher. The participants' confidentiality, privacy, and anonymity were protected during the study, and the information gathered was only utilized for research purposes. Furthermore, because this was a voluntary involvement, participants were free to leave the research at any moment.

3.12. Limitations of the study

The possible limitations of the research study have been observed as follows:

-Limited Resources

The study will be hampered by a lack of resources, since it will take longer to finish

- Online Platforms.

SME owners take longer to answer to telephone interviews, and some do not react at all, which will slow down the study's progress. All invites made to SME owners will be followed up on by the researcher.

-Covid-19 would limit Walk-ins

Since the world and South Africa are dealing with the COVID 19 Pandemic, walk-ins to SMEs will not be possible because doing so would risk contaminating the virus. As a result of this, the study will take longer to complete than it would under normal circumstances.

There is also a lack of representativeness, which will have an impact on how insights are obtained in the target group.

3.13 Conclusion

This chapter has made an outline on how the research will be conducted, the chosen research design is a case study which will enable the researcher to generate an in-depth, multi-faceted understanding of the complex issue at hand (exploration of the Human-Robot Collaboration Framework potential for sustainability on Durban SMEs). Furthermore, the various approaches were outlined, and the chosen approach of the study is the qualitative approach. In addition, the study will use interviews as the method used to collect data. The researcher targets a sample of 20 virtual interviews (where saturation will be reached on the qualitative study). The sample size is large enough to sufficiently address the phenomenon of interest and address the research questions at hand. Regarding ethical consideration the study will obtain ethical clearance from the Humanities Social Science department. The anonymity in the study will be maintained, self-determination and confidentiality will also be ensured during the conducting of telephonic interviews and report writing. The next chapter will focus on the presentation of the collected primary data using questionnaires.

CHAPTER FOUR: PRESENTATION OF PRIMARY DATA

4.1 Introduction

This chapter presents the of findings of the exploratory study of the Human-Robot Collaboration´s potential for sustainability in Durban SMEs. The primary aim of this chapter is to present the analysis of the primary data that was collected through in-depth interviews. The collected data is presented in the form of word clouds which are deemed as effective illustrations of depicting relations and trends. The findings presented are from six interviews that were conducted. A total of 20 interview requests to Durban based SMEs were made and a response rate of 30% was achieved (a total of 6 respondents were interviewed), as the remainder pulled out from participating in the study

The structure of the questionnaire comprises of two sections. Section A which will present demographic information of SME owners or managers and section B which will present the discussion of the research findings.

SECTION A

4.2 PRESENTATION OF DEMOGRAPHIC INFORMATION OF RESPONDENTS

4.3 Table 1. The gender of the respondents

GENDER	MALES	FEMALES
	1	5

Table 1 Table 1 illustrates the participant's gender who were interviewed on the study. The findings reveal that the majority of the respondents to the study were female (83%).

4.4 Table 2. The race of the respondents

RACE	AFRICAN	INDIAN
	5	1

Table 2. Demonstrate the respondent's race. The findings of the study reveal that the majority of the participants were Africans accounting 83% and the remainder of the participant were an Indian accounting 17%.

4.5 Table 3. The highest level of education of the respondents

HIGHEST LEVEL OF EDUCATION	MATRIC	BACHELOR'S DEGREE	HONOURS DEGREE
	1	2	3

Table 3 shows the highest level of education of the participants, the findings of the study reveal that the majority of the participants hold Honours Bachelor's degrees, the two other participants hold bachelor's degrees and one participant has matric.

4.6 Table 4. Field of study

FIELD OF STUDY	COMMERCE	SOCIAL SCIENCES	HEALTH SCIENCES	NATURAL SCIENCES
	3	1	1	1

Table 4 Illustrates the field of study of the participants, the findings of the study reveal that the majority of participants (3) are in the commerce field, marketing, natural sciences, and health sciences have 1 participant each.

4.7 Table 5. Participants practical experience prior to owning their businesses

PRACTICAL EXPERIENCE PRIOR TO OWNING A BUSINESS	NONE	1-5 YEARS	6-10 YEARS	11 YEARS +
	1	3	1	0

Table 5 illustrates the participant's years of practical experience in running their businesses. The respondents were asked the number of years they have been in. The findings of the study reveal that the

majority of participants have been in business for a period of 1-5 years and the rest of the participants have been in business for a period of 6-10 years and participants who had no experience at all.

4.8 Table 6. Position occupied in the business

WHICH POSITION DO YOU OCCUPY IN THE BUSINESS?	OWNER/MANAGER
	6

Table 6 illustrates the positions occupied by the respondents. The findings of the study revealed that all the six participants are owners of their enterprises.

SECTION B

4.9 PRESENTATION AND DISCUSSION OF INTERVIEW FINDINGS AS PER RESEARCH OBJECTIVES.

This section consists of the presentation and discussion of the primary data gathered through interview.

4.10 Research objective one- SMEs perception of the fourth industrial revolution.

4.10.1 Figure 1, perceptions of industry 4.0.

The word cloud (figure 1) presents the term technology as a frequently appearing term followed by easier, information and intelligence. Robots, computers, traditional and artificial intelligence appear as minor terms in the word cloud.

Theme: Advanced technology

Subthemes: Artificial intelligence

Robots

Computers

The majority of respondents stated that industry 4.0 is about advanced technologies (such as collaborative robots, artificial intelligence and computers among others) that will make life easier. The respondents indicated that it is an industrial revolution which builds from the third industrial revolution, but it is now more advanced, moving away from the traditional methods of doing business but to being more advanced and complex digital.

On the other hand, one respondent highlighted about knowing the third industrial revolution more than the fourth. The respondent further stated that its very useful she would assume, because they are able

to communicate with others and do work more efficiently whereas for example maybe, previously it would take longer for her in terms, patients would have a delay in therapy if they did not have immediate access to them so now it is just making a phone call or using a website to try and gain as much information as possible which helps the person to understand what they require and what services they provide as well.

The word cloud was generated off quotes such as:

"*A new way of living, industrialised technology and everything, a new way of improving business efficacy, being virtual basically. Living virtual basically, less face-to-face in a easier way*"

"*It can be seen as a positive enemy, a positive being in that it makes things easier for us to do and it reaches a wider audience in a quicker space of time*"

"*For now, it is quite hectic to fully understand what it exactly it means especially for us as Africans, but when we go online and study about the fourth industrial revolution, we get to understand that it is something that has to do with technology that much of human work has been lessened more of technological things*"

4.10.2 Figure 2. Industry 4.0 technologies SMEs likely to adopt.

Figure 2. Word cloud showing industry 4.0 technologies SMEs likely to adopt.

The term computer, app, artificial, intelligence and social media occur as major terms which implies the technologies the businesses can make use of. The term website, phones and printer occur as minor terms.

Themes: Computer and a laptop

Artificial intelligence

Website

Social media

Phone

Printer

The findings reveal that the respondents will likely adopt a computer, machines and artificial intelligence (such as autonomous robotics that will perform task on their own that are also able to collaborate with humans). The respondents pointed out that these types of technology will enable their business to reduce waste on their operations while reaping economic returns, thus maintaining sustainability. Furthermore, three respondents highlighted that they will adopt an app that will enable the customers or clients to reach out to them in the efficient way. In addition, the participants stated that they will adopt social media apps like Facebook and Instagram which is where they will be able to advertise their businesses and it is where the majority of their target markets are. The respondents reiterated that the apps would enable their businesses to attract a large customers or clients base no matter which part of the world they are at. Having such technology enables the entrepreneurs to schedule meetings virtually and close deals without having to personally meet the clients or customers. Some of the respondents also highlighted that their businesses have a website where clients can access their services or get to see the services the business offers. The findings also revealed that smartphones will play an essential role in the operations of the businesses one respondent made an example of having apps such as zoom and Microsoft teams where sales are closed.

"Apps and those things you know. I think those are the ones the most useful ones they can use you know, even though its hard to create one but the exposure, on Facebook, social media you know"

"You know ideally in terms of booking an appointment and stuff like that it could be done by an app"

"I have mentioned we utilising a website and all those things. On the website people are able to access emails and there's and basically send an email if they have a question or if they have an issue or you know anything about services provided. But in an ideal world, artificial intelligence would be able to give you a set of answers to specific questions"

"Artificial intelligence and autonomous machines"

"An e-commerce business and artificial intelligence in the future as my business becomes a large company"

4.10.3 Figure 3. showing the value offered by industry 4.0 technologies.

The terms effective occurs as a major term which symbolises the value of industry 4.0 technologies the participants would make use of. The term online, easier, money also occurs as a major terms.

Theme: **Online**

Effective

Money

Efficiency

The findings revealed that all the respondents fully agreed that the value which will be offered by the industry 4.0 technologies they identified is cost effectiveness and efficiency. Cost effective and efficiency, efficiency in terms of working hours, robots can work 24 hours whereby human beings work eight hours as per the South African constitution, and a human being needs money and needs extra over time to be paid. The machine needs maintenance only. It will be cost effective because a robot will cover work for ten people all on its own. And production will be quick which will generate money for the businesses.

Furthermore, the respondents argued that the machines will not go on strike, take leave or resign but the machinery will work non-stop as programmed to perform that specific function as part of the operations of the business. The respondents highlighted that a single robot could perform a task performed by ten people all by itself, this entails the pace or speed of which production will take place. Moreover, the technology will only need maintenance to carry out its task(s). Furthermore, the

respondents reiterated that the industry 4.0 technologies they identified will enable their business to have a greater reach to their target audiences.

The findings also reveal that industry 4.0 technologies will improve the quality of life, enhance safety and bring more comfort. One of the respondents argued that working from home and carrying duties virtually is all made possible by industry 4.0 technologies. The respondent further highlighted that customers and consumers can shop at the comfort of their homes through apps and the items the customers bought online be delivered to their homes. The findings also revealed that the customers book appointments via an app and visit the company's website for further details about a certain product or direct enquiries virtually is all because of the fourth industrial revolution.

The findings also show that value of industry 4.0 is what all the SME owners have been waiting for, life is going to be much easier, much safer than before argued the respondents. The level of quality, the level of how things will be done much easy than they used to be before, when the entrepreneurs want to go and register a company maybe there by SEDA they normally waited in the line but now they have introduced online portals here in South Africa you just go online and then you register without waiting for any queue you can access it anytime and anywhere.

In addition, one respondent pointed out that the only worry will be about making the product and delivering the product to the customer, since everyone is going online, like everyone is online, COVID helped entrepreneurs realise that a lot of people are on social media go reach out to more people at a cheaper cost, even with advertising you can even advertise more online than actually on billboards and everything and also living on an environment, that is environmentally friendly.

The respondents stated as follows:

"I think they will be cost effective they will save me a lot of money. And They'll save me a lot of money and save me a lot of time"

"Industry 4.0 technologies will improve the quality of life, enhance safety and bring more comfort. One of the respondents argued that working from home and carrying duties virtually is all made possible by industry 4.0 technologies"

"*Being virtual going e-commerce I will be able to reach more people, therefore have more customers at a quicker and easier way that will require me less money on actually getting people to promote the actual labour to process orders and everything"*

"*Oh its reaching a wider audience through social media, which could be harder to do with a word of mouth but its reaching a wider audience and people seeing that my work is actually reliable if they see that I have a large following, so its reaching more people*

4.11 Research objective one-SMEs challenges in transitioning into the fourth industrial revolution.

4.11.1 Figure 4. Challenges faced by SMEs transitioning into industry 4.0.

The word cloud (figure 4) presents the terms, information, online as frequently appearing terms. The terms resources, and Covid appear as minor terms.

Theme: Information

Subthemes: Lack of resources

Covid

Two respondents indicated that they have no challenges as they will not likely adopt industry 4.0 technologies. The respondents argued that their businesses do not need robots. At this moment where they are, the only technology they can think of is a printer and a laptop everything is very hands on, a phone and the internet. That is basically the technology that they are using. Furthermore, three out of six participants highlighted that the major challenges they face transitioning into the fourth industrial revolution is the lack of capital or resources such as finances and the lack of information. There is not enough information about the fourth industrial revolution in terms of getting out there for or small businesspeople to know about it and how to get more information on how to adapt to the industrial revolution and its challenges.

One of the respondents stated that it is difficult for the business to position itself in the market using the traditional methods (such as d as the business will not attract customers, small and medium businesses have difficulty in building their presence as customers do not trust them as there a lot of fly by nights. The respondent went on to say that the big businesses that are well established are attracting customers as they have reputation.

The findings also reveal that Covid made things worse for SMEs. The findings show that the Covid 19 crisis is much more difficult as a lot of people have lost their jobs and businesses are struggling and a lot of people closed their businesses so its really hard and especially start-ups business owners.

"*Finance is the first thing. There isn't much in formation in SMMEs in how to adapt on the fourth industrial revolution*"

"Lack of resources basically, uhm because like for me I started my business with no capital basically, its lack of resources in the economy of South Africa being so bad, but we just try we don't have the resources to prepare ourselves to invest for the long-term planning like literally resources in terms of money"

"That is what we face and the level of understanding of the fourth industrial revolution some of us are still stuck in in doing things traditionally you see, so I think that might be the problem for us SMEs"

"It will be quite expensive to get robots and this whole thing of the fourth industrial revolution"

"The business is not ready for the fourth industrial revolution with the fear that the fourth industrial revolution is here to replace human labour with robots despite robots being too efficient".

"So that side of the business hasn't been affected, there is also this thing of uhm in architecture that does designs for you so imagine now if someone who was going to be a potential client finds this uhm, this program and uses it to her design now I could lose business, so it can be both positive and negative"

"I have realised is that more companies that have already been established big companies are the ones that benefit more on the fourth industrial revolution because they already have their own target audience or the audience that they have they have big brands it is easy for them to move online because they are already have that social presence but for us as small SMEs it is very hard to advertise online since we are not known much about who we are you know, so you cannot just go online and say this is who I am you know, just like the other businesses could trust you since there are so many fly by nights and fake things you know people who do wrong stuff to people you know, so they may think that we are other thugs or for us small businesses, so for us it is very hard to gain the trust"

We do not need robots. At this moment where I am the only technology I can think of is a printer and a laptop everything is very hands on, a printer a laptop and a phone and the internet. That's basically the technology that I am using"

"The lack of finances, lack of information, truly we just lack and now we just experienced the COVID 19 crisis so things have just gone down spiral so its even worse than it was before"

4.12 Research objective two- The manner in which SMEs will overcome the challenges of not fully transitioning into the fourth industrial revolution

4.12.1 Figure 5 showing SMEs proposal to overcome industry 4.0 challenges.

The words government, finance, information occur as a major terms on the word cloud. On the other hand, the term country occurs as minor term symbolises the role the government needs to play on businesses.

Theme: Government (SEDA)

Information

Subtheme: Finance

One respondent indicated that she has no challenges as she will not likely adopt industry 4.0 technologies, the respondent argued highlighted that her business has adopted advanced industry 4.0 technologies to aid the production and operations of the business. However, the third respondent stated that her designs are very unique and personal to the client, so she makes sure that for instance the architectural side of things she makes sure she understands the challenges the client is currently experiencing in their space since she is designing.

Moreover, two respondents indicated that more information is needed regarding industry 4.0 as its still on the introductory stages in South Africa. The respondents argued that more information that will educate them as entrepreneurs on what industry 4.0 is all about, including the pros and cons of industry 4.0 technology. Further to this, the respondents argued that they do not think South Africa is in good state to transition into the fourth industrial revolution as it has not fully transitioned into the third industrial revolution.

Lastly, last three respondents stated that the government needs to raise awareness regarding the fourth industrial revolution. The respondents stated that they are hoping the government will provide some aid, but stated the challenges of obtaining financial aid, not given to certain races and the corruption involved in the issuing of aid.

The word cloud was developed off quotes such as:

"Honestly for now I think it is going to be a long journey, because us as a country I do not think we are fit enough economically to adapt to the fourth industrial revolution because I as a country we cannot even purify our own gold we rely on others to do it for us and it comes back more expensive to us while it is our commodity you know so I do not think as a country we are ready for the fourth industrial revolution yes it has been introduced but it has been adopted by those big businesses such as banks institutions, all those big businesses you know, but us as SMEs I do not think we fit in much well because we do not have enough finance to fund our selves and given the covid 19 crisis it is much more difficult"

"What I could suggest is like I have said before the lack of information, so if maybe the government or I don't know who can just try to advertise thing give us more information and say how they will support us because covid messed things for all of us especially financially, so I do not think, it is really going to be tough we have really a long way to go"

"I think the only way that will help us to overcome these challenges is only by education, obtaining knowledge for regarding the fourth industrial revolution because even here in South Africa we are still in the introduction of the fourth industrial revolution that's what I believe, so if us as managers, directors, CEOs and marketers we can put ourselves in line with or try to make sure that we get as much information as we can, about the fourth industrial revolution we attend workshops because somewhere somehow the workshops that are done you know about the fourth industrial revolution so if we can put ourselves in those lanes of where we get information the fourth industrial revolution will be able to help us".

"*I just wish the country like the government offers like proper preparations because the thing is taking over, but the country is not ready like I do not know how we going to adjust so fast once like , it has started already but once it has started over I do not know if were ready you know and I don't know if the government is going to do that thing but anyways maybe if the government needs to step up you know otherwise what is going to happen to this country then if we not prepared and it has taken over would that means that south Africa will be run by the world, like what is going to happen to like us the business"*

4.13 Research objective three- The manner on which the current use of collaborative robots will lead to sustainable entrepreneurship.

4.13.1 Figure 6, showing SMEs readiness in adopting collaborative robots.

The word cloud (figure 6) reveals the term business, ready, think occur as major appearing terms.

Theme: Businesses

Subthemes: Ready

The findings reveal that two out of six respondents indicated that their businesses are not in a state of being ready to adopt collaborative robots. The respondents argued that their enterprises are very far in adopting collaborative robots due to lack of capital or resources (such as finances and machinery). However, the respondents indicated that when the enterprises are stable, they will definitely adopt collaborative robots. Its big conglomerates that are in a better state of adopting collaborative robots at the moment. Moreover**,** two of out of six respondents highlighted that their businesses are ready to adopt collaborative robots. The two respondents reiterated that collaborative robots will enhance production, efficiency and effectiveness in their enterprises

The findings reveal that the respondents are passionate and excited and ready for the fourth industrial revolution as it will bring vast opportunities for entrepreneurs (such as reaching to more customers, increased production and reduce waste) and as a youngster and an upcoming entrepreneur the participant is still learning more about industry 4.0. The participant went on to urge academics to write more papers regarding the fourth industrial revolution to educate entrepreneurs.

Lastly, one of the respondents argued that the country is not ready for industry 4.0 and SME are not ready to adopt industry 4.0 technologies because there is a lack of finances, lack of information.

Furthermore, industry 4.0 will be of great benefit to big businesses that have the means of adopting them but as for small and medium enterprises it will be cumbersome to adopt collaborative robots

The word cloud was developed off quotes such as follows:

"I do not think we're ready to adopt the fourth industrial revolution technologies, well this is for my business, I am speaking for myself I don't think my business is ready, because I've just started up, uhm my business is still young it is still growing"

"*It is not ready, because you need vast amounts of capital and we not there yet. Yeah, I feel like big major companies can afford that. Robots? No! we not there yet. In fact, I think most members of the economy in South Africa are not there yet"*

"For now, I would be lying [laughs] I have never thought of that. We are not ready.

"*I will be using that robot to be able to make fast food products"*

"*We are super ready who would not want to adopt robotics for increased production"*

"we are already having issues with coal mining and diamonds and gold…As we quickly use it, I foresee a big problem but rather on a larger scale for the world not just for businesses"

4.13.2 Figure 7, word cloud showing collaborative robot's role in sustainability.

The word cloud (figure 7) reveals the term environment as a frequently appearing term and the terms economic and social are not so frequently appearing.

Theme: Environment

Economic

Social

The findings reveal that adoption of collaborative robots will enable their enterprises to balance the three capitals of sustainability, economic, social and environmental sustainability. However, the respondents argued that the adoption of collaborative robots will not do justice for the people as they fear collaborative robots will take people's jobs and companies have started retrenching employees. The findings reveal that on the social impact is also about making a happier environment, because one can pay you're his or her bills, you are happier as an individual you understand and you have less stresses if you can buy a meal, if you can pay your rent and if you can travel.

Furthermore, on the environmental aspect the participants highlighted that their enterprises would produce less waste and will use organic products and reusable or renewable products which will do less harm to the environment by designing products in such a way that they are recyclable. Moreover, the findings show that the respondents are very interested in the environment and sustainability because they want to deal with renewable energies, so whatever that they do they are very cautious and they are still learning more, the respondents are still trying to get more information about sustainability and there is go green environment thing that was promoted, the respondents want to associate their businesses with those kind of things that do not affect the environment, not only now but also for the future

consideration. Consequently, one respondent argued differently in that sustainability is more about robotics and its where technology is moving but she is more concerned more about what people are doing for the environment. The fourth industrial revolution will come with enormous pollution as the country is facing horrendous pollution from gold mines. In addition, there will be unsustainable ways of using natural resources.

On the economic side, the participants highlighted that the robots would produce large volumes which will generate high returns or profit as the robots are programmed to produce faster with less waste, the robots will not be complaining about working hours compared to humans.

The word cloud was developed off quotes such as these:

"*Economy will ensure sustainability economy wise because we would be able to produce fast and making money but, socially I don't think so because here in South Africa we have a problem of employment and if we implement one of industry 4.0 technologies or whatever that means I'll be behind less with it as well because the unemployment rate will be higher. Environmentally I am not hundred percent sure, but I don't think it affects it that much it will probably only affect it on manufacturing or making of the robots and the machines and maybe the components*"

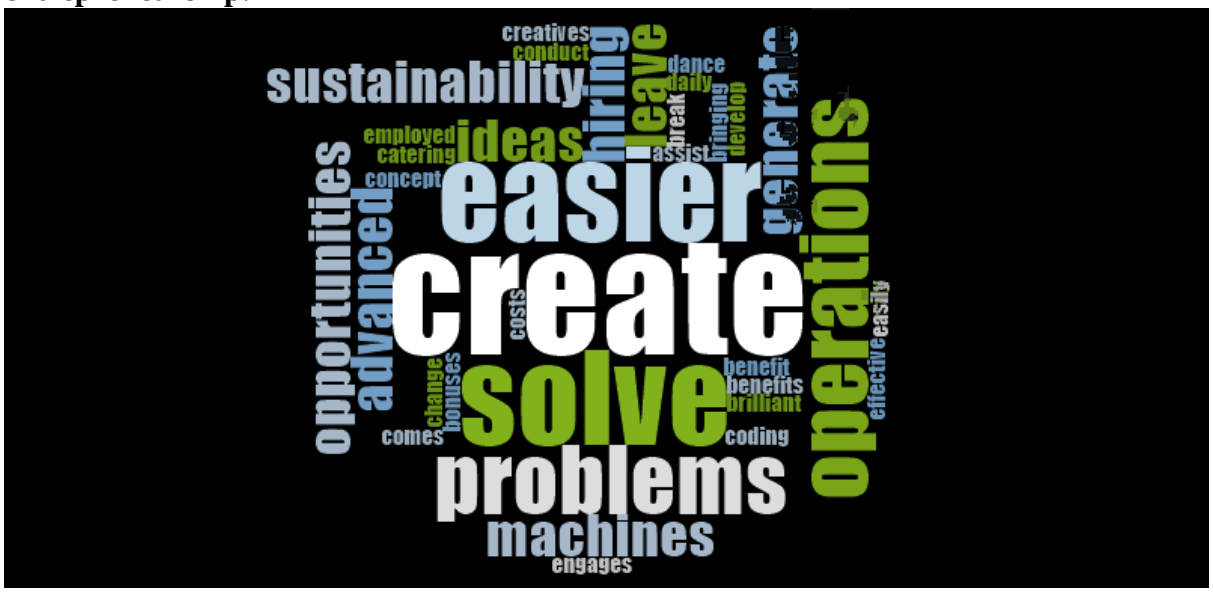
"*Regarding sustainability, obviously a human would get tired the same work we would as a robot can be programmed to do that, but also it will not have, as much as we can say yes it will be positive to have a robot do the same thing that humans can do"*

"*Economically I think they would contribute hugely because they would be working nonstop and they will not be complaining that they are tired like people… It is a form of giving back to the people, but you know what people say when you come and operate your business in their community you must hire them, you have to provide employ for them that will make them feel secure, and so they'll be probably support you throughout….Because my business is already engaging in environmental sustainable practices so adopting those two types of 4IR technologies I've mentioned before, it will just add in towards we have they will just enhance our strategies and on how we do business and how wee engage in environmentally sustainable practices*"

"As I have mentioned before so that, economic will be generating income and distributing among the workers"

"*Nature is also affected because it may cause pollution. So, if people are producing the product there is less pollution you know and the way I would, make my product would be that the materials used are not affecting the, it I s basically, it is also recycling so that's also helping the nature part of things*"

4.13.3 Figure 8, word cloud showing collaborative robots role on sustainable entrepreneurship.



The word cloud (figure 8) reveals the term environment and sustainability as frequently appearing terms. The term create, solve, easier and operations also appears but not as frequent terms. The terms sustainability, opportunities, technologies, leave and ideas appear as minor terms.

Theme: Enhanced production or Operations

Subthemes: Easier

Solve

Sustainability problems

The findings reveal that collaborative robots will provide entrepreneurs with new opportunities as they adopt collaborative robots. In addition, collaborative robots will enable entrepreneurs to generate great returns as the collaborative robots will produce in large volumes which in turn generates great revenue as robotics do not go on leave and work non-stop. The findings also reveal that the businesses will engage in digitalisation that will enable the business to reduce waste by engaging in environmentally sustainable business practices. Furthermore, the findings reveal that the collaborative robots will solve sustainability problems and make life more easier for SMEs.

"*Adopting those technologies they would just enhance production*"

"Entrepreneurs would be able to think of new things able to manage the business properly because they will worry less about the operations because the robotics will be there to help them and the business will grow faster therefore more entrepreneurs who have an idea can use robotics to help with the managing of the business like the operations like there's less tasks that entrepreneurs has to worry about"

"It would be much more easier for us because entrepreneurs are different people with their own imagination, you know of how they see things and how they want to see things you know it will be much it would really give more opportunities to entrepreneurs to explore their imaginations and to see themselves able to solve the problems that we never thought they'll be able to solve you know"

4.14 Research objective four- The impact future implementation of collaborative robots will have on manufacturing on the factory floor.

4.14.1 Figure 9. The future implementation of collaborative robots will have on manufacturing on the factory floor.

Theme: **Enhance**

Programmed

Production

Efficient

The findings reveal that collaborative robots will definitely enhance production on the factory floor. The respondents stated that the advantage of collaborative robots is that they are efficient and are programmed to perform complex tasks that humans alone cannot execute. In addition, the collaborative robots will produce in large volumes in a quicker or shorter space of time because the robotics are programmed to produce large quantity of goods in a timely manner, One respondent argued differently, stating that the collaborative robots will not enhance production on her enterprise looking at the line of practice she is in but believes it will enhance for other fields.

"They will enhance them because, they will be doing something that is different something that has never been explored before and the type of work they will be producing in a limited amount of time"

"Yes they will enhance manufacturing yeah they will do, the factories will manufacture faster products, so the lead, the lead time will be shorter and lead time will be shorter, so products will come to you faster then it did before and time is money that is the key factor so yeah I think it will enhance it"

"*Quicker production its better production flow*"

"*Yes it would really lead, …okay while we first introduce it, it might be hard because you know people like to do the same stuff that they always been doing because its hard to accept change, we always wanted to do the old things that we always we believe its what we want you know, its how we wanted to learn more so at first it might be hard but once they learn to understand and learn more about robots its going to be a very beautiful relationship between robots and workers, employees I believe so"*

4.14.2 Figure 10 illustrating the relationship between employees and collaborative robots.

The word cloud (figure 10) presents the term humans and employees as frequently appearing terms, symbolising the relationship humans and employees will have with collaborative robots. The term production also appears but not as a frequent term. In addition machine intimidated and unemployment appear as minor terms.

Theme: Humans

Employees

Subthemes: Unemployment

Intimidated

The findings reveal that the collaborative robots will have a good working relationship with employees. The respondents highlighted that it will be exceptional as the advantages and disadvantages of both are combined which will introduce new ideas, increase production flow. Furthermore, it will be more efficient with robots, especially in the textile industry it will play a major role because of robots, if some are sewing others are cutting, it will be very efficient. The results also highlight that there will be enhanced production when the two merge but it might be hard because you know people like to do the same stuff that they always been doing because it is hard to accept change, they always wanted to do the old things that they always believed it is what they wanted. The respondents also argued that the there will be a good working relationship between humans and robots however, the humans will be intimidated by the fact that the robots will take their jobs and unemployment will sky rocket.

"There will be fast production at the factory floor as humans collaborate with robotics"

"*Yes, it is because humans can introduce new ideas into the design or the product machines can increase production flow, humans you are creating income and employment for the humans, you are able to increase production with the robots, yeah it would be very beneficial if they were to both be utilised on the production flow*"

"The operations are going to get better you know so if the employees are happy that means my business is actually going to do well"

"*To a certain extent they would but I don't think uhm humans especially employees will want that because that would mean that some of the work will get given to robots and the humans will lose their jobs which means it create more unemployment"*

4.15 Conclusion

This chapter has made a presentation of findings on structured interviews on the 6 Durban SMEs. This chapter consists of two sections, with section A giving demographic information of respondents and Section B detailing data that was presented in the form of word clouds which were deemed as effective illustrations of depicting relations, trends and themes. Detailing quotes were presented to provide further explanations. The next chapter which is chapter five will provide a discussion of the results and data analysis

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Introduction

The previous chapter, which is chapter four gave the presentation of findings, detailing data that was presented in the form of word clouds which were deemed as effective illustrations of depicting relations, trends and themes. Detailing quotes were presented to provide further explanations. The purpose of this chapter is to provide a discussion of the results in relation to existing literature from chapter two. The aim of this chapter is to discuss the of the results in light of what was known about the research problem under investigation and to explain the insights and themes that emerged as a result. The findings of the study are discussed in relation to the research objectives as presented in chapter one.

The first research objective unpacks what the fourth industrial revolution is. The perceptions indicated that fourth industrial revolution is about advanced technologies, artificial intelligence, robotics and computers. Moreover, the results indicated that the enterprises will likely adopt technology such as computers, smart phones, apps and website. The value offered by industry technologies includes cost effectiveness and efficiency, industry 4.0 technologies will improve the quality of life, enhance safety and bring more comfort. Likewise, the machines will not go on strike, take leave or resign but the machinery will work non-stop as programmed to perform that specific function as part of the operations of the business which means that the enterprises will be generating a lot of profit. Lastly, the COVID 19 pandemic helped entrepreneurs think out of the box and adopt new strategies of doing business which are aligned with the COVID 19 pandemic.

The second research object discusses the challenges the SMEs face in transitioning into the fourth industrial revolution. The SMEs face challenges such as lack of resources, lack of enough information pertaining industry 4.0 and the effect of the COVID 19 pandemic. Moreover, on the third research objective discusses the solutions to the impediments that are hindering SMEs into transitioning into the fourth industrial revolution. The findings revealed that information should be accessible, the findings also reveal that the government (SEDA) needs to raise awareness regarding the fourth industrial revolution and lastly, provide SMEs with financial capital that will enable them to overcome the challenges of transitioning into industry 4.0.

In addition, the fourth research objective discusses the manner of which the current use of collaborative robots will lead to sustainable entrepreneurship. On the Social aspect of sustainability, the findings showed that the adoption of collaborative robots will aid the wellbeing of the communities where the enterprises operate by hiring the local personnel. On the environmental aspect the results revealed that enterprises would produce less waste and will use organic products and reusable or renewable products which will do less harm to the environment by designing products in such a way that they are recyclable. On the economic side, the findings revealed that the robots would produce in large volumes which will

generate high returns or profit as the robots are programmed to produce faster with less waste, the robots will not be complaining about working hours compared to humans.

Lastly, the fifth research objective discusses the impact the future implementation of collaborative robots would have on manufacturing on the factory floor. The results revealed that the future implementation of collaborative robots will enhance manufacturing on the factory floor. Likewise, the results pointed that the factories would manufacture products more fasters, the lead time will be shorter which means the products will reach to customers quicker than it did before.

5.2 Research objective one- SMEs perception of the fourth industrial revolution.

5.2.1 Advanced technology

From the respondents that were interviewed, the findings reveal that the respondents know what industry 4.0 entails. The majority of respondents highlighted that industry 4.0 is about advanced technologies (such as collaborative robots, artificial intelligence and computers among others) that will make life easier. The respondents indicated that it is an industrial revolution which builds from the third industrial revolution, but it is now more advanced, moving away from the traditional methods of doing business but to being more advanced and complex digital.

However, one respondent highlighted knowing more about the third industrial revolution as opposed to the fourth. The respondent highlighted the importance of the fourth industrial revolution, in that it will be essential for in her line of practice by attracting a large customer base by taking advantage of the Internet of Things (IoT).

These results of the study tie well with previous studies wherein World Economic Forum (2018); Skobelev and Borovik (2019) Industry 4.0 is about advanced technologies that provided a foundation for an increased digitization of the business environment, driven by the rise in the volume of data, computational power, the emergence of business intelligence and analytics and the improvement in the transferring digital instructions to the physical world. The key components or technologies of industry 4.0 include the Internet of Things (IoT), big data analytics, artificial intelligence, cloud computing and robotics among others.

5.2.2 Artificial intelligence

Two respondents highlighted that the fourth industrial revolution is about artificial intelligence, these include collaborative robots, computer systems among others. The study's findings are in line with the findings of Pareira and Romero (2017) who stated that industry 4.0 is a new industrial era that embraces

a set of industrial developments pertaining artificial intelligence, the Cyber-Physical Systems (CPS), the Internet of Service (IoS) Internet of Things (IoT), Big data analytics, robotics and cloud-based manufacturing among others.

Lu (2019) on the other hand highlighted that Industry 4.0 is now under progress, with cyber physical systems (CPS) production features based on heterogeneous data and knowledge integration. CPS' key responsibilities are to meet production's flexible and dynamic needs, as well as to increase the industry's overall effectiveness and efficiency. Furthermore, the findings are in line with study conducted by Thames and Schaefer (2016), which found that the aims of Industry 4.0 are to increase operational efficiency and productivity as well as automatization.

A similar conclusion was reached by Nahavandi (2019, p.01) who stated that the fourth industrial revolution holds many possibilities and as it provides social and economic possibilities by way of the paradigm shift pertaining working in organizations, creation of new business models and advanced production technology. This was verified by Qin, Liu and Grosvenor (2016) who reiterated that, businesses will create more effective and efficient communication channel between the various stakeholders of the business will be created and enhanced from factories, suppliers, distribution, customers or final buyers. In addition, businesses will create new versions of products will be generated made possible by smart manufacturing.

5.2.3 Robots

The findings further revealed that two of the respondents indicated that industry 4.0 is about robotics. The respondents highlighted that robots are efficient and are programmed to perform complex tasks that humans alone cannot execute. In addition, the robots will produce in large volumes in a quicker or shorter space.

A study conducted by Qin, Liu, & Grosvenor (2016) pointed that more effective and efficient communication channel between the various stakeholders of the business will be created and enhanced from factories, suppliers, distribution, customers or final buyers. Production costs, waste and resource utilization will be reduced. Therefore, the future of business will have an autonomous status and with a transmitted fast response rate all made possible by robotics.

5.2.4 Computers

The findings discovered that computers are associated with the fourth industrial revolution. The respondents highlighted that computers are the major common industry 4.0 tool or technology that is accessible to them. However, computers were introduced in the previous revolutions. The respondents

might not be aware but referred to the advanced computers which also make use of the Internet of Things. In addition, the respondents they know more about the third industrial revolution as opposed to the fourth, which is in line with the findings of Schwab (2017) who stated that the third revolution introduced information and communication technology to automate production.

Moreover, one of the respondents highlighted that he is passionate and excited and ready for the fourth industrial revolution as it will bring vast opportunities for entrepreneurs (such as reaching to more customers, increased production and reduce waste) and as a youngster and an upcoming entrepreneur the participant is still learning more about industry 4.0. The study suggests that academics write more papers regarding the fourth industrial revolution to educate entrepreneurs.

5.3 Industry 4.0 technologies SMEs likely to adopt

5.3.1 Artificial intelligence

The study discovered that the majority of respondents will likely adopt machines and artificial intelligence (such as autonomous robotics that will perform task on their own that are also able to collaborate with humans). The respondents pointed out that these types of technology will enable their business to reduce waste on their operations while reaping economic returns, thus maintaining sustainability. The findings of Bataller & Harris (2016) are broadly in line with the study, in that both the public and private sectors, Artificial Intelligence has the potential to bring about change and benefits. Digital workplaces, so-called intelligent systems, and labour and capital augmentation, in which AI augments the retention of skilled workers, all lead to reduced costs and effectiveness. Moreover, AI can perform activities at a speed that is beyond human capacity (Purdy & Daugherty, 2016, p. 5). However, the respondents did not go into detail as they may be not aware of the different types of technologies that fall under artificial intelligence such as self-driving cars, machine learning and intelligent robots among others.

5.3.2 App

The findings of Brosig (2014, p.03) pointed that mobile communication has become an essential part of the fourth industrial revolution. Data must be recorded and reviewed in as many locations as plausible for the desire of digitalization to become a reality. However, having access to this data from anywhere, if possible, is just as important. Cloud based manufacturing, in its ideal state, is not confined to a single location but rather consists of a global supply chain. This is made possible by an app. These results demonstrated are in line with the study's findings. The researcher discovered that three respondents highlighted that they would adopt an app that will enable the customers or clients to reach out to them in the efficient way, no matter the part of the world the clients are located. An app is user friendly, easy to use and cost effective.

5.3.3 Social Media

In addition, the respondents stated that they will adopt social media apps like Facebook and Instagram which is where they will be able to advertise their businesses and it is where the majority of their target markets are. The respondents reiterated that the apps would enable their businesses to attract a large customers or clients base no matter which part of the world they are at. Having such technology enables the entrepreneurs to schedule meetings virtually and close deals without having to personally meet the clients or customers. The results demonstrated are broadly in line with the findings of Pareira & Romero (2017) who signified that the vision of Internet of Things (IoT) and Internet of Services (IoS) enables the creation of effective communication between smart machines and humans leading to the establishment of smart products that are environmentally sustainable and cooperation between employees in the work environment (Pareira & Romero, 2017).

5.3.4 Website

Some of the respondents also highlighted that their businesses have adopted a website where clients can access their services or get to see the services the business offers. The customers are able to browse through the services the enterprises offers and book for appointments.

Herceg, Kuc, Mijuskovic and Herceg (2020, p.01) produced a similar pattern of results, by pointing out that the adoption of the Industry 4.0 technologies includes (Cyber Physical System, Cloud-based manufacturing, Internet of Things etc) has become the source of competitive advantage for an enterprise, as well as on the national level. On the other hand, Bondar, Hsu, A. Pfouga and Stiepandic (2016) argued that the Cyber-Physical Systems (CPS) As a new technology, it is projected to provide potential solutions to alter the functioning and role of many existing industrial systems. However, when comparing the results of previous studies, it must be pointed that the respondents did not mention the fourth industrial revolution technologies aforementioned technologies as they did not know the technical terms.

5.3.5 Smartphone

The findings also revealed that smartphones compatible with the Internet of Things (IoT) will play an essential role in the operations of the businesses one respondent made an example of having apps such as zoom and Microsoft teams where sales are closed. Previous studies of point that the ostensibly "smart" devices are part of the "Internet of Things," as it is now known (IoT). The Internet of Things (IoT) allows a wide range of devices to connect and communicate over the Internet, making life easier in ways that many people never imagined. The respondents might not have been aware that the smart phones are part of the Internet of Things. According to the GSM association (2014, p.2), IoT can

underpin solutions that improve decision-making and productivity in manufacturing. A similar conclusion was reached by Skobelev and Borovik (2019) who stated that the key components or technologies of industry 4.0 include the Internet of Things (IoT), big data analytics, artificial intelligence, cloud computing and robotics among others.

5.4 The value to be offered by industry 4.0 technologies

5.4.1 Effective

The findings revealed that all the respondents fully agreed that the value which will be offered by the industry 4.0 technologies they identified is cost effectiveness and efficiency. Cost effective and efficiency, efficiency in terms of working hours, robots can work 24 hours whereby human beings work eight hours as per the South African constitution, and a human being needs money and needs extra over time to be paid. The machine needs maintenance only. It will be cost effective because a robot will cover work for ten people all on its own. And production will be quick which will generate money for the businesses.

These findings are building on the exiting evidence of Schwab (2017) who highlighted that from the operational perspective, digital technologies, such as CPS, are proposed to reduce set-up times, labour and material costs and processing times, resulting in higher productivity of production processes. A similar conclusion was reached by Kagermann et al. (2013); Porter and Heppelmann (2014). However, when compared to other studies Kagermann et al. (2013); Porter and Heppelmann (2014); Schwab (2017) pointed out that the Industry 4.0 principles are offered to allow organizations to have flexible production processes and analyze massive volumes of data in real time, hence boosting strategic and operational decision-making for SMEs. Advances in industry 4.0 technologies enabled the creation of embedded and connected systems Jazdi (2014); Kagermann et al. (2013); Brettel et al (2014). These systems attempt to monitor and regulate the equipment, conveyors, and products through a feedback cycle that collects a large amount of data (big data) and updates the virtual models with actual process information, resulting in a smart factory (Wang et al., 2015, 2016; Gilchrist, 2016).

5.4.2 Money

The respondents argued that the machines will not go on strike, take leave or resign but the machinery will work non-stop as programmed to perform that specific function as part of the operations of the business which means that the enterprises will be generating a lot of profit. The respondents highlighted that a single robot could perform a task performed by ten people all by itself, this entails the pace or speed of which production will take place. Moreover, the technology will only need maintenance to carry out its task(s). Furthermore, the respondents reiterated that the industry 4.0 technologies they identified will enable their business to have a greater reach to their target audiences. The results

demonstrate that the industry 4.0 technologies will generate great financial returns for the enterprises as the technologies are programmed and industrious on executing complex tasks as compared to the human worker. The results tie well with the findings of Technavio (2016) who stated that robots are progressively being used in production processes to reduce operational costs and enhance economic viability. Furthermore, companies would be able to maintain revenue and profits and risks more proficiently by measuring the impact of the business model and provides to customers on the financial statement in real-time or on-line and optimizing sales and delivery times by robotic systems in distribution networks (Dirican, 2015).

5.4.2 Efficiency

The findings also reveal that industry 4.0 technologies will improve the quality of life, enhance safety and bring more comfort. One of the respondents argued that working from home and carrying duties virtually is all made possible by industry 4.0 technologies. The respondent further highlighted that customers and consumers can shop at the comfort of their homes through apps and the items the customers bought online be delivered to their homes. The findings also revealed that the customers book appointments via an app and visit the company's website for further details about a certain product or direct enquiries virtually is all because of the fourth industrial revolution.

The findings also show that value of industry 4.0 is what all the SME owners have been waiting for, life is going to be much easier, much safer than before argued the respondents. The level of quality, the level of how things will be done much easy than they used to be before, when the entrepreneurs want to register a company at SEDA they normally waited in the line but now SEDA has introduced an online portal in South Africa where entrepreneurs go online and then they register without waiting for any queue, the portals can be accessed anywhere and anywhere using gadgets which have access to the internet.

These findings are in accordance with findings reported by Qin, Liu and Grosvenor (2016) who reiterated that industry 4.0 has plentiful advantages such as revenue growth, enhanced operational efficiency, increased flexibility and quickness Consumer experience is also improved by Industry 4.0. Qin et al (2016) pointed out Industry 4.0 involves the existence of a comprehensive communication network connecting diverse enterprises, factories, suppliers, logistics, resources, and customers. Furthermore, each sector adjusts its configuration in real-time based on the needs and state of related network sections, maximizing profit for all cooperatives with limited sharing resources (Brettel et al., 2014; Jeschke et al., 2017).

5.4.3 Online

In addition, one respondent pointed out that the only worry will be about making the product and delivering the product to the customer, since everyone has gone online, like everyone is online, COVID helped entrepreneurs realise that a lot of people are on social media to reach out to more people at a cheaper cost, even with advertising you can even advertise more online than actually on billboards and everything and also living on an environment, that is environmentally friendly. The COVID 19 pandemic helped entrepreneurs think out of the box and adopt new strategies of doing business which are aligned with the COVID 19 pandemic. These results tie well with the findings of Pan and Zhang (2020) who stated that the COVID 19 pandemic has resulted in an abnormally high rise in the utilisation of digital advanced technology; for example, people use digital teleconference operating systems such as Google Meet, Zoom, and Microsoft Teams to help meet others virtually and assist professional people and workers working remotely, as well as students engaging in online learning.

Moreover, the findings of the study build on the existing evidence of Pan and Zhang (2020) in that customers can buy products and services through e-marketplace websites, and businesses can continue to operate as usual through e-commerce operators. By maintaining a new momentum, digital technologies can help people fight the COVID 19 pandemic and adjust to a new normal. Wut, Lee, Ip, Lee (2021) stated that the Internet of Things integrates many devices and has verified that using webs and supports "smart" offices, homes, schools, and logistics. However, Wut, Lee et al. (2021) argued that change occurs all over, and it is essential to manage the changes well in order to maintain long-term operations. Martin and Schouten (2012) on the other hand has shown that digitization has also resulted in a number of challenges, such as steadily increasing electricity usage, cybercrime security risks, and social disparities affiliated with the growing divide in exposure to communication and information technology, colloquially known as the 'digital divide'

5.5 Discussion of research objective two- SMEs challenges in transitioning into the fourth industrial revolution.

5.5.1 Challenges of transitioning into industry 4.0

5.5.1.1 Lack of resources

The findings revealed that the major challenges the enterprises face transitioning into the fourth industrial revolution are the lack of capital or resources such as finances and the lack of information, information on what the fourth industrial revolution is really about and the pivotal role the fourth industrial revolution will play in the sustainability of SMEs. Furthermore, the findings revealed that more companies that have already been established are the ones that benefit more on the fourth industrial revolution because they already have their own target audience or the audience that they have

they have big brands it is easy for them to move online because they are already have resources that allow them to have social presence but for SMEs it is very hard to advertise online since they are not known much about who they are because of the impediments of not having resources

In line with the study of Calitz, Poisat and Cullen (2017) the major challenges business encounter on transitioning into the fourth industrial revolution is the employee training required, technology implementation costs. The results demonstrated on the challenges SMEs face transitioning into the industry 4.0 tie well with the previous studies of Basl (2017); Muller, Kiel, Voigt (2018) reiterated that the barriers to industry 4.0 implementation are financial barriers, organisational challenges, managers and employee's competencies.

In line with these findings, Hall and Maffioli (2008); Kumar and Siddharthan (2013) argued that nonetheless, It is commonly understood that the adoption of modern technology might be more difficult for developing countries. Since the economies of emerging countries such as South Africa have historically been more focused on the extraction and commercialization of commodities, companies in these countries frequently lag behind their counterparts in developed countries in terms of technology adoption (Ramani, Thutupalli, Urias) (2017). According to Frank et al. (2016), additional factors such as ICT infrastructure, culture, level of education, and economic and political instability may all influence value perception and, as a result, the degree of investment in modern technology.

5.5.1.2 Information

The findings of the study revealed there is not enough information about the fourth industrial revolution in terms of reaching out to SMEs or small businesspeople to know about it and how to get more information on how to adapt to the industrial revolution and its challenges.

Similarly, when comparing the results of the study with previous studies, it must be pointed out that lack of information about industry 4.0 is also a major challenge for SME. A similar conclusion was reached by Calitz, Poisat and Cullen (2017) which pointed out the need for new skills and knowledge as there will be digitization of factories. These skills are complex problem solving, critical thinking, service orientation and quality control.

Moreover, the findings revealed that it is difficult for the business to position itself in the market using the traditional methods as the business will not attract customers, small and medium businesses have difficulty in building their presence as customers do not trust them as there a lot of fly by nights. The respondent went on to say that the big businesses that are well established are attracting customers as they have reputation.

5.5.1.3 COVID 19

The findings of the study also reveal that COVID 19 made things worse for SMEs. The findings showed that the Covid 19 crisis is much more difficult as a lot of people lost their jobs and businesses are struggling and a lot of people closed their businesses, so it is really hard and especially start-ups business owners. The results tie well with the findings of Wut, Lee, Ip, Lee (2021, p.1) who stated that the COVID 19 has had a significant impact on the global economy, particularly on business activities that have been hampered by lockdowns and other mobility restrictions. Economic recovery from the pandemic is expected to take a significant amount of time. COVID has had the greatest impact on various service sectors, including tourism and hospitality. On the other hand, Ramani et al. (2017) argued that there are structural issues that rising economies such as South Africa may confront, which might be a barrier to the implementation of Industry 4.0 One of them is that the rise of developing economies is built on low-cost labor, particularly in manufacturing, and this might discourage or hinder investments in automation and other technology, which are often more costly in these nations. A conclusion can be reached the COVID 19 pandemic was one of the major hurdles in the progress of SMEs and transitioning into the fourth industrial revolution.

5.6 Discussion of research objective three- The manner in which SMEs will overcome the challenges of not fully transitioning into the fourth industrial revolution

5.6.1 Overcoming Challenges

5.6.1.1 Information

The findings of the study reveal that, that more information is needed regarding industry 4.0 as its still on the introductory stages in South Africa. The respondents argued that more information that will educate them as entrepreneurs on what industry 4.0 is all about, including the pros and cons of industry 4.0 technology. Further to this, the respondents argued that they do not think South Africa is in good state to transition into the fourth industrial revolution as it has not fully transitioned into the third industrial revolution.

The findings tie well with the findings of Calitz, Poisat, & Cullen (2017, p.09) who pointed out that the importance of training and education in the introduction of Cobots has been emphasized. Companies benefit, technology understanding, and benefits are the most important training needs for the introduction of Cobots at the senior management level. ‘Knowing what is present on the market, how it can create a competitive edge, and how it can benefit the organization are the primary problems for senior management,' according to one responder. Greater technical training is required for the deployment of Cobots at the staff level Calitz, Poisat, & Cullen (2017, p. 09).

5.6.1.2 Government

The findings also reveal that the government needs to raise awareness regarding the fourth industrial revolution. The respondents stated that they are hoping the government will provide some aid, but stated the challenges of obtaining financial aid, not given to certain races and the corruption involved in the issuing of aid.

The findings of OECD (2016) point that government should act like a good gardener, "preparing the ground" (increasing human resources), "fertilizing the soil" (increasing research and development), "watering the plant" (increasing financial support for innovation), and "removing weeds and pests" (increasing financial support for innovation) (removing regulatory, institutional, or competitive obstacles to innovation). Given the severe trade and investment restrictions in comparison to other countries in the region and globally, removing weeds and pests is likely one duty that government has ignored the most (OECD 2016). Furthermore, in order to accelerate technology transfer and diffusion, barriers such as cumbersome policy and guidelines that raise the cost of doing business in the country must be removed as soon as possible (OECD, 2016).

5.6.1.3 Finances

The findings indicated that the respondents are hoping the government will provide some financial aid so as to enable their enterprises overcome the challenges they face on transitioning to the fourth industrial revolution. Moreover, the respondents further stated, an end to corruption and enforcement of a transparent procurement system can overcome the funding challenge.

On the other hand, the findings of Onyemere (2013) point out that the lack of financial support on SMEs is the primary inhibitor to SME growth and development. Moreover, the funds from the entrepreneur′s personal savings and financial support from family, relatives and friends is not sufficient to access institutional finance capital market and banks. Therefore, SEDA should fund the enterprises that have bootstrapped and who show growth potential and the willingness to adopt industry 4.0 technologies such as cobots.

However, when comparing the study's results to those of older studies, it must be pointed out that study corruption is the main obstacle hindering the growth and development in the country which in turn affects SMEs ability to adopt the advanced technologies. South Africa as an emerging country it has lower income levels compared to developed countries, which entails that the most consumed product is low cost, making lower price a more relevant factor in competitiveness than innovativeness. This market behaviour can clearly influence technology investment.

5.7 Discussion of research objective four- The manner on which the current use of collaborative robots will lead to sustainable entrepreneurship

5.7.1 Readiness

5.7.1.1 Ready

When comparing the study's results to those of older studies of Thutupalli and Urias (2017) and Frank, Dalenogare, Ayala (2019) it must be pointed out that the researcher found that the business owners are keen and ready to adopt collaborative robots as they will enhance production, efficiency and effectiveness in their enterprises. These results tie well with the findings of Calitz (2018, p.10) who pointed that employee qualities or attributes that are appropriate for engaging with Cobots and flourishing in the envisioned work environment include a willingness to learn, support for training and upskilling, acceptance of change, being technologically minded, and adjusting to new technology.

Similarly, the findings revealed that when the enterprises are stable, they will definitely adopt collaborative robots. Moreover, two of out of six respondents highlighted that their businesses are ready to adopt collaborative robots. The two respondents reiterated that collaborative robots would enhance production, efficiency and effectiveness in their enterprises

The findings of the study discovered that two out of six respondents indicated that their businesses are not in a state of being ready to adopt collaborative robots. The respondents argued that their enterprises are very far in adopting collaborative robots due to lack of capital or resources (such as finances and machinery).

The results tie well with previous studies wherein Stentoft, Rajkumar & Madsen (2017) argued that there is lack of support and guidance for SMEs in adopting advanced technologies such as the collaborative robots. Furthermore, the authors pointed out that the SMEs are overcautious on the kind and type of technology they are investing in. A similar conclusion was reached by Ramani, Thutupalli and Urias (2017) who argued that structural issues that rising economies such as South Africa may confront, which might be a barrier to the implementation of Industry 4.0 One of them is that the rise of developing economies is built on low-cost labor, particularly in manufacturing, and this might discourage or hinder investments in automation and other technology, which are often more costly in these nations.

Frank, Dalenogare, Ayala (2019) further argued thatSince the concept of Industry 4.0 is still relatively new, there is considerable uncertainty and a lack of understanding about the true effect and contribution of Industry 4.0-related technologies in the context of emerging nations in general. These findings are broadly in line with the study's findings as the study argued that the country is not ready for industry 4.0 and SME are not ready to adopt industry 4.0 technologies because there is a lack of finances, lack

of information. Furthermore, industry 4.0 will be of great benefit to big businesses that have the means of adopting them but as for small and medium enterprises it will be cumbersome to adopt collaborative robots.

Overall, these findings match those of PWC (2017) signifying that the fourth industrial revolution technologies, require advanced skills and knowledge which are far beyond basic literacy, taking into consideration of the complex nature of the fourth industrial revolution

5.7.2 Collaborative robots and sustainability

The findings reveal that adoption of collaborative robots will enable their enterprises to balance the three capitals of sustainability, economic, social and environmental sustainability.

5.7.2.1 Social

On the Social aspect of sustainability, the findings showed that because of industry 4.0 the, adoption of collaborative robots will aid the wellbeing of the communities where the enterprises operate by hiring the local employees. The upliftment of the communities though social support programs and community development programs. In addition, the employee's wellbeing will be maintained as they do not have to perform complex tasks in production that puts their lives at risk but will be executed in collaboration with robots.

The findings of Sarango-Lalangui et al. (2018) tie well with the study′s, by stating that the social aspect of sustainability involves good corporate governance in the society the businesses operate on, which integrates the needs of workers which wider society with the aim of doing business in an ethical manner and which takes care of the livelihood of the local communities.

On the contrary, the respondents highlighted that the collaborative robots or industry 4.0 technologies will not do justice for the people as they fear collaborative robots will take people's jobs and companies have started retrenching employees A similar conclusion was reached by Abele & Reinhart (2011) that the social dimension demographic factors are a challenge where communities livelihoods are not enhanced by the enterprises operating in their community

5.7.2.2 Environmental

On the environmental aspect the results revealed that enterprises would produce less waste and will use organic products and reusable or renewable products which will do less harm to the environment by designing products in such a way that they are recyclable. Moreover, the findings showed that the respondents are very interested in the environment and sustainability because they want to deal with

renewable energies, so whatever that they do they are very cautious, and they are still learning more on how to engage in environmentally sustainable ways. Furthermore, the results showed that respondents are still trying to get more information about sustainability, the enterprises engage in go green environment campaign thing that was promoted, the respondents want to associate their businesses with those kinds of things that do not affect the environment, not only now but also for the future consideration. Consequently, one respondent argued differently in that sustainability is more about robotics and its where technology is moving but she is more concerned more about what people are doing for the environment. The fourth industrial revolution will come with enormous pollution as the country is facing horrendous pollution from gold mines. In addition, there will be unsustainable ways of using natural resources.

This is consistent with what has been found in previous of Hentout, Aouache, Akli (2019) who pointed out that the collaboration between humans and robots will revolutionise the production and manufacturing on the enterprises by removing dull, dirty, and redundant tasks from human operators where possible to achieve sustainability. A similar pattern of results was demonstrated by (Hollinger, 2016) who asserted that collaborative robots would reduce product failure and wastage. Safe operating systems on the factory floor will be ensured by reliability and trust between the intelligent robot and the human worker which will ensure flawless production, minimum waste and efficiency in pursuit of sustainability (Nahavandi, 2019).

5.7.2.3 Economic

On the economic side, the findings revealed that the robots would produce large volumes which will generate high returns or profit as the robots are programmed to produce faster with less waste, the robots will not be complaining about working hours compared to humans. When comparing the results of the study with previous studies, the results tie well with

A similar pattern of results was obtained by Nahavandi (2019) who highlighted that Collaborative robots are robots that are aimed at working with humans on the workstation or factory floor to perform tasks and ultimately achieve sustainability goals

5.7.3 Collaborative robots and sustainable entrepreneurship

5.7.3.1 Operations

The findings revealed that collaborative robots will provide entrepreneurs with new opportunities as they adopt collaborative robots. The enterprises will worry less about the operations because the robotics will be there to help them, and the business will grow faster therefore more entrepreneurs who have an idea can use robotics to help with the managing of the business like the operations. more about

coding robots, in restaurants on how they will take orders and service them when they break down. In line with the studies of (Hentout, Aouache, Akli (2019) the collaboration between humans and robots will revolutionise the production and manufacturing across the world by removing dull, dirty, and redundant tasks from human operators where possible to achieve sustainability. Intelligent robots and systems will penetrate supply chains on an unprecedented level. Galin and Meshcheryakov (2019) pointed that the idea of the utilisation of cobots in industry was coupled with skepticism due to the available solutions avoiding direct interaction between humans and robots. However, the trend has changed over time, the humans and robots can work together to attain greater efficiency while taking int account the safety measures.

5.7.3.2 Create

The collaborative robots will enable entrepreneurs to generate great returns as the collaborative robots will produce in large volumes which in turn generates great revenue as robotics do not go on leave and work non-stop. This signifies that the programmed nature of robots will work tirelessly in the workstation optimising production

Moreover Tsarouchi et al. (2016) provides compelling findings by arguing that, the most important point in considering the business case for sustainability is that it does not have a negative impact on the business' ability to generate profits. In fact, in the long run, it is perceived to significantly improve revenue and profits by reducing costs and increasing competitive advantage.

5.7.3.3 Sustainability problems

The findings also reveal that the businesses will engage in digitalisation that will enable the business to reduce waste by engaging in environmentally sustainable business practices. Furthermore, the findings reveal that the collaborative robots will solve sustainability problems and make life easier for SMEs. The results imply that enterprises are wary of their business operations and will engage in sustainable operations that will enhance the wellbeing of the environment by engaging in lean production.

These results tie well with previous studies wherein Ghazilia, Sakundarini, Hanim, Abdul-Rashid, Ayub, Olugu, and Musa (2015) pointed out that collaboration of technology (robotics) and humans will enable sustainable entrepreneurship to be geared towards the implementation of green strategies and techniques that are more efficient in the reduction of waste. Likewise, the sustainable entrepreneurship processes will be designed in such a way that they have a low environmental impact. Lastly, sustainable entrepreneurship in industry 4.0 will adopt new business models that will prevent pollution, reduce the usage of non-renewable energy sources, the manufacturing and production of goods that are eco-friendly, and the redesigning of business of products and processes. Contrary to the findings of Ghazilia et al. (2016), Tsarouchi, Spiliotopoulos, Michalos, Koukas, Athanasatos, Makris and Chryssolouris

(2016) reiterated that environmentally sound companies can also have a strategic edge when it comes to attracting consumers and investors. Modern customers are aware of social and environmental concerns and keep themselves updated about which companies in the society behave responsibly. Investors are equally conscious of these concerns and the shift towards engaging in environmentally friendly businesses is increasing

Lastly, the study's finding go beyond previous reports of Ghazilia et al. (2016) and Tsarouchi et al. (2016). The study found that sustainability is more about robotics and its where technology is moving but there is great concern about what people are doing for the environment. The fourth industrial revolution will come with enormous pollution as the country is facing horrendous pollution from gold mines.

5.8 Discussion of research objective five- The impact future implementation of collaborative robots will have on manufacturing on the factory floor

5.8.1 The future implementation of collaborative robots will have on manufacturing on the factory floor.

5.8.1.1 Enhance

The findings revealed that the future implementation of collaborative robots will enhance manufacturing on the factory floor. The respondents highlighted that the enterprises do not have to pay the collaborative robots or pay for employees that are on leave, sick leave, and having to pay those employees bonuses, for collaborative robots they work non-stop and enhance productions by producing in enormous volumes in a short time frame with the products arriving quicker to customers.

The findings are directly in line with previous findings of Benotsmane, Dudás and Kovác (2018) stating that Significant changes are taking place in industrial production, which will alter the way things are done. Decentralized control will take the place of currently managed production processes that are centralized. The underlying principle of the Industry 4.0 concept in industrial processes is the introduction of network-linked intelligent systems, which are centered on the self-regulating capacity of machines, tools, elements, components, and product lines that interact with one another.

5.8.1.2 Programmed

The respondents stated that the advantage of collaborative robots is that they are programmed and can perform complex tasks that humans alone cannot execute. In addition, the collaborative robots will produce in large volumes in a quicker space of time. However, one respondent argued differently, stating that the collaborative robots will not enhance production on her enterprise looking at the line of

practice she is in but believes it will enhance for other fields this could have been the less knowledge the respondent had of collaborative robots.

The findings are directly in line with previous findings, which tie well with the findings of Simoens (2019) who pointed out that the cooperation between humans and robots, will result in humans working fearlessly with robots knowing that the cobots (collaborative robots) fully comprehend them and have the ability to collaborate with them in the factory floor or workstation. Moreover, the human operator performs tasks which require dexterity and or decision making while the robot recognizes parts that are not suitable and replaces that part with another appropriate part with the aim of achieving sustainability (Hentout, Aouache, Akli, 2019).

5.8.1.3 Production

The findings revealed that collaborative robots will definitely enhance production on the factory floor. The respondents highlighted that the factories would manufacture products more fasters, the lead time will be shorter which means the products will reach to customers quicker than it did before. Moreover, the respondents pointed that time is money which translate to enterprises adopting collaborative robots that that will speed up the manufacturing process.

The study's results tie well with the studies of Gubán and Kovács (2017) who stated that, as the global marketplace is growing, where the needs and demands of customers are continuously evolving, production enterprises have to ensure they improve efficiency, focus more on cost reduction and profitability so as to enhance their competitive edge. Furthermore, the production systems need to be more advanced and flexible to quickly respond to the ever-changing needs of customers and economic environment. A similar pattern of results were obtained by Benotsmane, Dudás and Kovác (2018, p.03) who pointed that it is critical for manufacturing firms to provide cost-effective and high-quality products, which may be accomplished through maximizing resource utilization and minimizing production costs

The essence of the Industry 4.0 concept in manufacturing processes is the introduction of network-linked intelligent systems, which are based on the self-regulating ability of machines, equipment, components, workpieces, and products that communicate with one another (Benotsmane et al., 2018).

5.8.2 Relationship between employees and collaborative robots

5.8.2.1 Humans

The results demonstrated that the collaborative robots would have a good working relationship with employees. The respondents highlighted that the working relationship with cobots on the factory floor will be exceptional as the advantages and disadvantages of both are combined which will introduce new ideas, increase production flow.

In line with the findings of Simoens (2019) it can be argued that the cobots will be aware of the human presence and will therefore ensure safety and risks that emerge, the collaborative robots will notice, feel not only the human they are working with but the also the set goals and expectations of the human operator. Not only will humans learn how robots execute a task cobots will also watch and learn how the human operator performs a task and once they master the task, they will then operate the same task which will lead to the enhanced production and ultimately great financial returns. Calitz et al. (2018) further argued that there are robot characteristics will have the most significant impact on promoting human–robot trust, these characteristics are performed as designed, function to standard specification, dependability and seeing the benefit of working collaboratively. In contrary, the findings of Calitz (2018) point out that the psychological roles and demand placed by robotics on employees are stress and job security. Furthermore, the study indicated that the employees fear being replaced by robotics and the fear of the unknown and having the pressure to perform in a structured manner without reasoning ability.

5.8.2.2 Intimidation and Unemployment

The study has discovered that fear of redundancy, retrenchment, and rising unemployment are the key challenges for South African enterprises on introducing cobots at the employee level.

However, when comparing the results of the study with previous reports it can be argued that there will be enhanced production when the two merges (humans and robots) but it might be hard because people like to do the same stuff that they always been doing because it is hard to accept change, they always wanted to do the old things that they always believed it is what they wanted the transition instils fear on SMEs. In addition, the employees fear that the robots are here to take their jobs and replace them.

A similar pattern of results was found by Calitz (2018) who pointed tat in the long run, emotional support may be required because the job may become lonely without the presence of other humans, and ‘basic computer skills and good hand-eye cooperation are major training requirements for employees.

5.9 Conclusion

The chapter has provided a discussion of the results. Moreover, the study used thematic analysis to analyse the qualitative data. The results pointed that the majority of respondents know what industry 4.0 is about advanced technologies (such as collaborative robots, artificial intelligence and computers among others) that will make life easier. On the challenges facing SMEs, the findings revealed that the challenges SMEs face transitioning into the fourth industrial revolution is the lack of capital or resources such as finances and the lack of information, information on what the fourth industrial revolution is really about and the pivotal role the fourth industrial revolution will play in the sustainability of SMEs. However, overcoming the challenges the findings revealed that more information that will educate them as entrepreneurs on what industry 4.0 is all about, including the pros and cons of industry 4.0 technology.

The results revealed that most businesses are ready to adopt collaborative robots. Moreover, the findings of the study also revealed that collaborative robots will play an essential role on sustainability by enabling SMEs to balance the three capitals of sustainability. Cobots will play a prominent role in sustainable entrepreneurship as it will provide entrepreneurs with new opportunities as they adopt collaborative robots. In addition, collaborative robots will enable entrepreneurs to generate great returns as the collaborative robots will produce in large volumes which in turn generates great revenue.

In addition, the study's findings revealed that employees will have a good working relationship collaborative robot. Collaborative robots will enhance manufacturing as that they are programmed to perform complex tasks that humans alone cannot execute. In addition, the collaborative robots will produce in large volumes in a quicker space of time as they collaborate with humans on the factory floor. The next chapter that is chapter six will present the conclusion and recommendations for future research on the results that were discussed on this chapter and the limitations that the study encountered.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The results discussed in the previous chapter have demonstrated that the adoption of collaborative robots will have the potential to create sustainable enterprises as the findings revealed that collaborative robots aid the wellbeing of the communities where the enterprises operate by hiring the local personnel, produce less waste and the usage of organic products and reusable or renewable products which do less harm to the environment by designing products in such a way that they are recyclable. Furthermore, the discussion revealed that the robots would produce in large volumes which will generate high returns or profit as the robots are programmed to produce faster with less waste. Thus, balancing the capitals of sustainability. This chapter concludes the study and provides recommendations based on the findings of the research, which was the exploration of the Human-Robot Collaboration´s potential for sustainability on Durban SMEs.

This study adopted a qualitative approach. The qualitative approach allowed the researcher to make an in-depth interpretation of the human-robot collaboration's potential to create sustainable enterprises in Durban. Therefore, this study has explored the potential of the Human-Robot Collaboration and the manner on which Durban SMEs can adopt collaborative robots that will collaborate with humans which will ensure sustainable production, thus reducing waste, taking care of the society they operate in while reaping economic returns. This chapter also discusses the limitations and areas for future research.

6.2 CONCLUSIONS

The study focuses on the human-robot collaborations potential to create sustainable enterprises in Durban. The data was collected from entrepreneurs whose businesses operate in Durban. The study concludes the following on the following research objectives:

Research objective one: SMEs perception of the fourth industrial revolution

A conclusion can be drawn that the majority of SMEs know what the fourth industrial revolution is, artificial intelligence and robotics were the major industry 4.0 technologies identified by the enterprise owners. However, there is still a gap as some enterprise owners do not know what industry 4.0 is, they know more about the third industrial revolution.

In addition, enormous profit would be made by the enterprises due to the programmed nature of industry 4.0 technologies which adds value in terms of cost effectiveness and efficiency in terms of working hours, this entails that production is quick due to the efficacy of industry 4.0 technologies.

The researcher concludes that industry 4.0 enables the enterprises to meet the needs and demands of stakeholders from shareholders, customers or consumers communities where they operate. However,

the safety of customers is at risk as most transactions are done online. This means enterprises should strengthen cybersecurity measures of protecting their customers and communities who are doing the transactions.

Research objective two: **SMEs challenges in transitioning into the fourth industrial revolution**.

Durban SMEs have minimal information on what the fourth industrial revolution is, this can be attributed to the fact that the fourth industrial revolution is an its introductory stages in South Africa. The funding issue is also a major drawback as the majority of the enterprise owners are inhibited in transitioning into the fourth industrial revolution. Hence, the enterprise owners cannot upskill themselves and have the technological know-how in line with the fourth industrial revolution. Likewise, the challenges hampering SMEs are aggravating the digital literacy divide as some enterprise owners are unable to adopt technologies that enables them to be abreast with the technological changes taking place, possessing a business acumen that enables the enterprise owners to think strategically in adopting business models that counter the technical changes taking place. In addition, the atrocities translate to enterprises not being able to adopt industry 4.0 technologies such as robotics that enables them to produce in large amounts in a quick time space at the same time reducing the impact the enterprises have on the environment.

Research objective three: The manner in which SMEs will overcome the challenges of not fully transitioning into the fourth industrial revolution

Industry 4.0 is a new era and thus South Africa as a developing country has not fully transitioned int this new era as enterprises do not have a deeper understanding of what it is and what it entails. Further to this, the findings pointed that lack of financial support is one of the major impediments on the enterprises not being able to transition and to adopt the advanced industry 4.0 technologies. A conclusion can be drawn that sustainable investments on the enterprises as they are deemed unfundable. This would make the transition into industry 4.0 smoother and thus lessening the gap that enterprises know of industry 4.0. As a result, the enterprise owner managers would counter the technological changes taking place, thus giving the enterprises competitive advantage and the creation of a more sustainable city.

Research objective four: The manner of which the current use of collaborative robots will lead to sustainable entrepreneurship

A conclusion can be drawn that the fourth industrial technology is the amicable solution to the sustainability challenges enterprises encounter. The keenness of the enterprises to adopt collaborative robots entails that the enterprises engage in sustainable operations that enhance the wellbeing of the environment by engaging in lean production and ultimately create a sustainable environment. Further

to this, the enterprises are to aid the social well being of the communities they operate in, the standard of living eventually getting higher due to the employment of local personnel. As a result, the safety of employees is guaranteed as the more complex tasks are executed by cobots. On the contrary, employees fear that robotics might replace them as most enterprises have started retrenching their employees due to the adoption of advanced industry 4.0 technologies. A conclusion can be drawn that enterprises should educate their employees about the advantage and importance of cobots in terms of working efficiently and that cobots are not there to replace employees.

A conclusion can be drawn that less pressure is put on the environment as the collaboration between humans and robots reduces the production of waste, less depletion of non-renewable and scarce resources. The enterprises are wary of the impact they are having on the environment and are thus learning more about sustainability. As a result, the enterprises are adopting ways to create environmentally friendly products like the usage of organic products. Further to this, the enterprises are to make great financial returns by taking advantage of the programmed nature of cobots and the collaboration with humas which produces in large amounts in a quicker time space. Consequently, the researcher concludes that this gives the enterprises competitive advantage against their rivals or competitors by taking advantage of economies of scale which will attract a large customer base and the creation of reputable enterprises with exceptional customer service.

Research objective five: The impact the future implementation of collaborative robots would have on manufacturing on the factory floor

The researcher concludes that the collaborative robots would have a good working relationship with employees. The working relationship with cobots on the factory floor would be exceptional which would introduce new ideas, increase production flow in high volumes in a quicker space of time and less production of waste by the enterprises. The factories would manufacture products more fasters, the lead time being shorter which means the products are to reach to customers quicker than it did before. Moreover, the findings revealed that time is essential which translate to enterprises adopting collaborative robots that speeds up the manufacturing process. As a result, manufacturing is enhanced due to the programmed nature of collaborative robots, thus enabling that the wellbeing of society and the environment are taken care of while making enormous profit from the massive production taking place.

6.3 RECOMMENDATIONS

The following recommendations were made based on the findings of the study:

Research objective one recommendations: SMEs perception of the fourth industrial revolution

Safety of the digitalisation process.

The results pointed that the enterprises would engage in digitalisation and take advantage of the Internet of Things (IoT) in efforts to reduce waste and the impact waste has on the environment and the creation of apps and online portals for customers to use when requiring the services of the enterprises. However, safety concerns are at stake which puts the enterprises confidential information and resources at risk as more hackers are online. The study recommends enterprises to be wary of the risks and ensure their confidential information and resources are secure.

Education and training need

The results pointed that a small portion of the enterprise owners do not know what the fourth industrial revolution is. As a result, the enterprises do not have adequate information that will educate or teach them more about industry 4.0. Therefore, this study suggests that education and training can help to address the issue.

Research objective two recommendations: SMEs challenges in transitioning into the fourth industrial revolution.

SMEs to re-design their business models to be in line with industry 4.0

The results pointed that the is no sufficient industry 4.0 information. Thus, the study recommends SMEs should design their business models to electronic commerce (ecommerce) made possible by the Internet of Things (IoT), in order to be abreast with the technological changes taking place and remain competitive and importantly reduce the impact on mother nature's resources.

Research objective four recommendations: The manner of which the current use of collaborative robots will lead to sustainable entrepreneurship

Employees intimidation by collaborative robots in taking their jobs

The results pointed that the SMEs are ready to adopt collaborative robots as they will have an exceptional relationship with employees. However, the employees are intimidated by cobots in taking their jobs and replacing them. with this in mind SME owners should communicate the importance of adopting collaborative robots to their employees, to stress that cobots are not there to take employees

jobs or threaten them, but to collaborate with the employees in order to enhance production and execute the complex task humans alone cannot execute but can execute successfully in collaboration with cobots. The study also recommends enterprises to invest in the upskilling of employees to make use of robots.

Investing in collaborative robots to create sustainable enterprises.

The results pointed that the adoption of collaborative robots by SMEs will ensure that employee's wellbeing would be maintained as they would not have to perform complex tasks in production that puts their lives at risk but will be executed in collaboration with robots. On an environmental perspective, the study pointed that the adoption of collaborative robots would enable the enterprises to produce less waste thus having a minimal impact on the environment. The use of organic products and reusable or renewable products which will do less harm to the environment. the enterprises to produce in large volumes in a quicker space of time which will generate high returns or profit as the robots are programmed to produce faster with less production of waste. The study recommends SME invest in the adoption of collaborative robots in order to create a sustainable environment and balancing social, environmental and economic sustainability.

6.4 LIMITATIONS

This study using SMEs as a case study is essential as it provides insights on the adoption of cobots. The limitation of the research is that the results may not be generalisable.

Despite the limitations, this study has provided insights on how SMEs can be sustainable enterprises through the adoption of cobots as SMEs a faced with balancing the three sustainability dimensions which results in the SMEs prompting other sustainability dimensions slide down their list of priorities**.** The sustainability issues include the ability to deal with economic, environmental and social changes, engaging in responsible and ethical business practices, efficiently using natural resources and protecting the environment, providing high-quality products and services and meeting stakeholder needs.

6.5 FUTURE RESEARCH

The results of the study have pointed that the increased shift to electronic commerce (e-commerce) by enterprises as means of creating a sustainable environment and to provide exceptional customer service, enterprises are opting for the adoption of industry 4.0 technologies to enable the enterprises to engage in digitalisation which will reduce waste, however, through the digitalisation process large amounts of electrical energy is used. Thus, future research should look at how artificial intelligence (AI) can reduce high energy usage in the digitalisation process.

In addition, more research needs to be done pertaining social sustainability and the human-robot collaboration. Employees would not have the deep personal connection with robots, the job may become lonely without the presence of other humans. Therefore, the researcher is of the view that employee's emotional intelligence will be affected while working with the cobots.

6.6 OVERALL CONCLUSION

SMEs play a pivotal role in the economy with the goods and services they offer. This study sought to explore the human-robot collaboration´s potential for sustainability on the SME**s.** Likewise, the manner on which the SMEs have encountered challenges in being in the fourth industrial revolution and how SMEs can overcome hinderances of adopting collaborative robots. Furthermore, the usage and future prospects of adopting collaborative robots as part of SMEs manufacturing that will ensure they engage in sustainable entrepreneurship, thus reducing waste, taking care of the society they operate in while reaping economic returns.

The findings have revealed the challenges the enterprises do not have adequate information about industry 4.0, the enterprises do not have enough resources and financial capital to adopt industry 4.0 technologies. However, the findings pointed that the government needs to raise awareness regarding industry 4.0, as industry 4.0 is still on the introductory stages in South Africa. Likewise, the results showed that enterprises are ready to adopt collaborative robots.

The adoption of collaborative robots is to aid the wellbeing of the communities where the enterprises operate in by hiring the local personnel. The upliftment of the communities though social support programs and community development programs. In addition, the employee's wellbeing would be maintained as they would not have to perform complex tasks in production that puts their lives at risk but will be executed in collaboration with robots.

In addition, the study has discovered that the adoption of collaborative robots by enterprises would enable the enterprises to produce less waste thus having a minimal impact on the environment. Furthermore, the usage and future prospects of adopting collaborative robots as part of SMEs manufacturing that will ensure they engage in sustainable entrepreneurship, thus reducing waste, taking care of the society they operate in while reaping economic returns. On an economic perspective the study has revealed that the adoption of collaborative robots will enable the enterprises to produce in large volumes in a quicker space of time which will generate high returns or profit as the robots are programmed to produce faster with less production of waste.

On the gaps that have been identified by the study, the study recommends that education and training can help to address the insufficient industry 4.0 information issue. Further to this, SME to invest in the

adoption of collaborative robots in order to create a sustainable environment and balancing social, environmental and economic sustainability as the results pointed that with the adoption of cobots balance the three capitals. In addition, as means of reducing the impact on the environment, enterprises have engaged in digitalisation which ensures the reduction of waste. However, Safety in the digitalisation process is as at risk due to an increase in cybercrime. Hence, the study recommended an enforcement of strict measures to protect company resources and customers. Future research should look at how artificial intelligence (AI) will reduce the energy usage in the digitalisation process. Lastly, more research needs to be done pertaining social sustainability and the human-robot collaboration. The researcher feels that employees would not have the deep personal connection with robots, the job may become lonely without the presence of other humans. Therefore, the researcher is of the view that employee's emotional intelligence will be affected while working with the cobots. As a result, social sustainability affected.

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ANNEXURE A: INFORMED CONSENT

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL

For research with human participants

Information Sheet and Consent to Participate in Research

Date:

Greetings,

My name is Njabulo Ntusi a registered student at the University of KwaZulu-Natal pursuing a Master of Commerce by full research under the school of Management I.T. and Governance (MIG), Pietermaritzburg campus. I can be contacted by phone at 078 1838 172 or by email at 216023534@stu.ukzn.ac.za

My academic supervisor is Mr Nigel Tawanda Farayi Chiweshe, based in the School of Management on the Pietermaritzburg campus of the University of KwaZulu-Natal. He can be contacted by e-mail at Chiweshen@ukzn.ac.za or telephonically at 033 260 5355.

You are being invited to consider participating in a study that involves human-robot collaboration's potential to create sustainable enterprises in Durban. The aim and purpose of this research is to investigate the manner on which Durban SMEs have encountered challenges in being in the fourth industrial revolution and how SMEs can overcome hinderances of adopting collaborative robots. Furthermore, the usage and future prospects of adopting collaborative robots as part of SMEs manufacturing that will ensure they engage in sustainable entrepreneurship, thus reducing waste, taking care of the society they operate in while reaping economic returns.

The study is expected to include a target population of 667 433 and a sample size of 384, the study will be conducted under the city of Durban. The duration of your participation if you choose to participate and remain in the study is expected to be an hour long.

The study may involve the following risks and/or discomforts, telephonic interview which may take a little longer. The benefit of participating in the study is that the findings of the study will be shared with you via email and your name will not be included. Your anonymity and confidentiality is of utmost importance and will be maintained throughout the study. Your participation in the interview is completely voluntary. You also have the right to withdraw at any time during the study.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number_____).

In the event of any problems or concerns/questions you may contact the researcher at 078 1838 172 or by email on 216023534@stu.ukzn.ac.za or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Your participation in the study is voluntary and by participating, you are granting the researcher permission to use your responses. You may refuse to participate or withdraw from the study at any time with no negative consequence. Your anonymity will be maintained by the researcher and the School of Management, I.T. & Governance and your responses will not be used for any purposes outside of this study.

All data, both electronic and hard copy, will be securely stored during the study and archived for 5 years. After this time, all data will be destroyed.

If you have any questions or concerns about participating in the study, please contact me or my research supervisor at the numbers listed above.

Sincerely

(Researcher name and signature)

CONSENT TO PARTICIPATE

I _____ have been informed about the study entitled An exploratory study of human robot-collaboration's potential to create sustainable enterprises in Durban by Njabulo Ntusi

I understand the purpose and procedures of the study

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher 078 1838 172 or through email at 216023534@stu.ukzn.ac.za

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview YES / NO

Video-record my interview YES/NO

_____ _____

Signature of Participant **Date**

_____ _____

Signature of Witness **Date**

(Where applicable)

_____ _____

Signature of Translator **Date**

(Where applicable)

ANNEXURE B: RESEARCH INSTRUMENT/ QUESTIONNAIRE

SECTION A: DEMOGRAPHIC INFORMATION

Please provide the following by ticking with an (x) in the appropriate box.

1 Gender:

Male	Female	Other

2 Race:

African	Coloured	Indian	White	Other

3. Highest Level of Education

Primary level	Matric	Diploma	Bachelor's Degree	Master's degree	Ph.D.	Other (please specify)

4 Please indicate the field of study:

Commerce	Health Sciences	Natural Sciences	Humanities	Law	Other (please specify)

5 Did you have any practical experience prior to owning your business?

None	1-5 Years	6-10 Years	11 Years +

6 Which position do you occupy in the business?

Manager	Owner	Other (please specify)

Section B: Collaborative-Robots and Sustainability

1 In your opinion what is industry 4.0?

2 In your opinion, what are some challenges faced by SMMEs such as yours and others in transitioning to industry 4.0?

3 On the challenges you have identified, how do you propose your SMME and others will overcome these challenges transitioning into industry 4.0?

4 What examples of industry 4.0 technologies do you think your SMME could make use of?

5 In your opinion, what value would be offered by the industry 4.0 technologies you identified?

6 What is the state of readiness of the business in adopting collaborative robots?

7 What role(s) would adopting industry 4.0 technologies or collaborative robots play in ensuring sustainability?

8 In your own opinion, what role do you think collaborative robots play in sustainable entrepreneurship?

9 In your own opinion, whether you have adopted or have not adopted collaborative robots, do you think the future implementation of collaborative robots will enhance manufacturing on the factory floor?

10 Do you think the working relationship between employees and collaborative robots will enhance manufacturing in the factory floor?

_____

_____

_____

_____

_____

_____

-THE END-

THANK YOU!!!

ANNEXURE C: ETHICAL CLEARANCE LETTER

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

29 March 2021

Mr Njabulo Ellias Ntusi (216023534)
School Of Man Info Tech & Gov
Pietermaritzburg Campus

Dear Mr Ntusi,

Protocol reference number: HSSREC/00002498/2021
Project title: An exploratory study of human-robot collaboration's potential to create sustainable enterprises in Durban
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 13 February 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 29 March 2022.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

ANNEXURE D: PERMISSION TO CONDUCT RESEARCH

15 December 2020

Dear Mr. Njabulo Ntusi (student number 216023534)

RE: **PERMISSION TO CONDUCT RESEARCH AS PART OF THE MASTERS DEGREE QUALIFICATION**

We are pleased to inform you that we accept your offer in conducting research which is part of your Masters research project under the topic: **An exploratory study of human-robot collaboration´s potential to create sustainable enterprises in Durban.** Provided the information that will be given to you will be used solely for the purpose of your research project and will be kept extremely confidential. And will not cause harm to the agency, society at large.

For any queries please do not hesitate to call us on (033) 264 3100

Thank you.

Mike Zondo (Branch Manager)