# Factors influencing innovative leadership in mobilising small and medium enterprises (SMEs) towards smart manufacturing in Pietermaritzburg

Submitted in fulfilment of the requirements of the degree of

**Master of Management Sciences in Administration and Information Management**

In the Faculty of

Accounting and Informatics

at the Durban University of Technology

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Date Submitted:

Supervisor: Dr Celani Nyide (DBA)      Date: 30/10/2023

# DECLARATION

I,Sydney Dumisani Maphumulo , declare that this dissertation is a product of my own intellectual effort and implementation. The present work has not been previously submitted to any academic institution or university for the purpose of obtaining another degree. The author has duly recognised all citations and sources, whether they are from published or unpublished works.

------ -------- 30/10/2023

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# APPROVAL FOR FINAL SUBMISSION

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# ABSTRACT

Small and medium-sized businesses (SMEs) are regarded as effective drivers of inclusive economic growth and expansion in South Africa and globally. After noting the significance of SMEs and their contribution to the economy, it is helpful to observe how their growth and sustainability is being maintained through the adoption and utilisation of smart manufacturing techniques and innovative leadership. Consequently, this study highlighted the significance of SME adoption of innovative leadership in smart manufacturing. The main aim was to critically examine factors influencing innovative leadership in mobilising SMEs towards smart manufacturing in Pietermaritzburg, KwaZulu-Natal (KZN), South Africa.

A quantitative research approach was adopted with census sampling; 102 manufacturing SMEs registered in the Msunduzi Municipality database participated. The data was analysed using the latest version of SPSS V 29.0.1. The findings of this research indicate that the use of robotic technology among manufacturing SMEs is very limited. Moreover, the adoption of internet of things (IoT) and artificial intelligence technologies is still very low. Therefore, the general finding is that the utilisation of smart manufacturing processes by SMEs in the manufacturing sector in Pietermaritzburg is still in its infancy. This study also found that there is substantial evidence supporting the presence of innovative leadership practices in SMEs operating in the manufacturing sector. This provides an opportunity for these companies to advance the smart manufacturing agenda through effective leadership. The study found a number of factors that had an impact on the use of smart manufacturing processes and innovative leadership.

**KEY WORDS: Smart manufacturing, Small medium enterprises; Innovative Leadership.**

# ACKNOWLEDGEMENTS

I would like to express my gratitude to the divine being for providing guidance throughout my academic journey at Durban University of Technology. The experience for me personally has been an extraordinary endeavour, with several individuals playing a significant role in facilitating my achievements. I express my gratitude in equal measure to my deceased parents, Mr and Mrs Maphumulo.

This study would not have been possible without the motivation of the following individuals:

My supervisor: Dr Nyide, I'd like to offer my heartfelt thanks for your encouragement, commitment, and for being patient with me on this path. Dr Nyide, you came through for me when I needed a supervisor. Thank you so much, Bhadela.

My family, friends, colleagues, and my beloved girlfriend for their constant support throughout this journey, and may the GOOD Lord bless you abundantly.

I would also like to acknowledge the Durban University of Technology at large with specific reference to the Centre for Excellence in Learning and Teaching (CELT), the library writing centre, my manager, Mr Le Roux, and the whole DUT Midlands Finance family.

Lastly, acknowledgements are extended to all those I have not mentioned by name who offered encouragement and assistance, enabling me to bring this work to completion.

To the Food and Beverage SITA – thank you for the bursary, it played a major role.

# DEDICATION

I dedicate the work to the Almighty God, asking for His guidance in completing it successfully and I dedicate this to my deceased parents, who served as a source of inspiration and provided me with strength at moments of discouragement. My parents consistently offered moral, spiritual, emotional, and economic assistance.

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# CHAPTER 1: INTRODUCTION AND BACKGROUND

## 1.1 INTRODUCTION

Small and medium-sized enterprises (SMEs) make a significant contribution to the economies of both emerging and industrialised countries. Innovation and leadership in this arena are critical since they help the SMEs create income while remaining competitive. This chapter describes the background of the study as well as its justification, and presents the problem statement, aim, and objectives. Furthermore, this chapter presents an overview of the chapters in this dissertation.

## 1.2 BACKGROUND OF THE STUDY

The ever-dynamic development of technology has always impacted firms, especially those within the manufacturing sector, in terms of cost structures, processes, and controls. For manufacturing firms to safeguard their sustainability and existence in the industry, they must keep investigating the techniques that provide them with a competitive edge, and adopt innovative manufacturing processes that are the best fit for their needs. Small and medium-sized businesses are critical to the country's social and economic development. SMEs have been identified as successful drivers of inclusive economic growth on the continent of South Africa and throughout the world (Sahoo and Yadav 2018: 1128). However, in South Africa, the growth and survival of SMEs is relatively low (Abdullrazak and Alyamani 2019: 237)

## 1.3 JUSTIFICATION OF THE STUDY

Small organisations are still hindered by their lack of technological implementation, regardless of excellent technological improvements globally (Lichtenthaler 2016: 82). The aforementioned author adds that without this technology, lack of technology in small organisations makes it difficult to them to compete or develop. Ngibe and Lekhanya (2019a: 18) assert that manufacturing processes are significantly affected by advances in internet technology, the internet of things (IoT), cloud computing, and artificial intelligence. As a result, production businesses globally have embraced and adopted smart manufacturing (Mittal *et al*. 2017: 195). Smart manufacturing guarantees a future of mass-generating and enormously customised products through responsive independent manufacturing operations (Cai, Huang, and Wang, 2017: 332). This study seeks to critically analyse factors influencing innovative leadership applied in mobilising SMEs towards adopting smart manufacturing processes in Pietermaritzburg.

## 1.4 RELEVENCE OF THE STUDY

The significance of small and medium companies (SMEs) in South Africa has particular relevance amongst the evolving landscape of trade liberalisation, regional economic integration, and advancements in information and communications technology Lekhanya (2015: 35) highlighted the importance of leadership and innovation in ensuring sustainable growth and leadership performance in these SMEs. The critical role of SMEs in South Africa can be easily identified in their ability to penetrate new markets and their creative ways to expand economies without only focusing on absorbing labour (Dalenogare *et al* 2019: 320). Having highlighted the importance of SMEs and their contribution to the economy, it is important that we also highlight how their growth and sustainability are maintained through the adoption and use of smart manufacturing processes and innovative leadership. Smart manufacturing is a new approach to manufacturing that uses technology and integrated manufacturing (Sikander 2018: 90). This study outlined the importance of SMEs adopting innovative leadership in smart manufacturing. While smart manufacturing is being embraced and adopted by many manufacturing companies globally, this study will fill the gap in the adoption of innovative leadership by SMEs and the usage of smart manufacturing within the South African context.

## 1.5 PROBLEM STATEMENT

There have been several research studies around innovation and entrepreneurship, and a common area of concern has been identified as the lack of innovative leadership in the majority of SMEs in South Africa (Littlewood and Holt 2018; Sitharam and Hogue 2016;281). According to Ngibe and Lekhanya (2019b: 69), the manufacturing industry in South Africa is now experiencing a significant deficiency of innovation culture, mostly attributed to inadequate leadership characterised by a lack of comprehension of leadership practices. This deficiency has subsequently affected the development of business management capacity within the sector. Dalenogarefrank and Ayala (2019); Ayandibu and Houghton (2017: 134) highlighted that the contributing factors include a lack of market knowledge in order to succeed in today's competitive landscape, and lack of a range of essential attributes such as: a solid foundation in education and training, a strong entrepreneurial drive, a keen orientation towards technology, proficiency in product distribution, and the ability to effectively network with others.

Lack of business skills hinders personal effectiveness, which is a key driver for the survival and growth of new SMEs, and this contributes to employees being discouraged from embracing their creativity and innovation in SMEs (Sekhametsi 2017: 89). Over and above the lack of business skills, the lack of technology has also contributed to restricting organisations' ability to produce a specific standard of products in order to compete in the local and international markets (Littlewood and Holt 2018: 525). The advancement in internet technology, the IoT, cloud computing, and artificial intelligence has profoundly impacted manufacturing (Ngibe and Lekhanya 2019a: 17-19). According to Helu (2015: 14), manufacturers often need technical expertise to traverse the variety and kind of innovations not currently accessible to enhance their systems, which poses a major barrier for smart manufacturing.

### 1.5.1 Research aim

The main aim of this study was to critically examine factors influencing innovative leadership in mobilising SMEs towards smart manufacturing in Pietermaritzburg.

### 1.5.2 Research objectives

To attain the research aim, the following objectives were developed:

- To determine smart manufacturing processes used by manufacturing SMEs in Pietermaritzburg.
- To analyse innovative leadership practices applied in manufacturing SMEs in Pietermaritzburg.

- To identify factors that affect the adoption of smart manufacturing processes by SMEs in Pietermaritzburg.
- To establish factors affecting the adoption of innovative leadership by SMEs pursuing smart manufacturing in Pietermaritzburg.

### 1.5.3 Research questions

- What are the smart manufacturing processes used by manufacturing SMEs in Pietermaritzburg?
- What are innovative leadership practices used in manufacturing SMEs in Pietermaritzburg?
- What are the factors affecting the adoption of smart manufacturing processes by SMEs in Pietermaritzburg?
- What are the factors affecting the adoption of innovative leadership by SMEs seeking smart manufacturing in Pietermaritzburg?

## 1.6 RESEARCH METHODOLOGY

To ensure the fulfilment of the study objectives, the researcher ensured that the research techniques and approaches adopted in this study were aligned with the needs of the study. A quantitative research method was thus used. This method is suitable for this study since the research objectives needed to be measured using statistics that use numerical estimates and through comparing, describing, and connecting features (Khumalo 2019: 38). The objective was to provide a concrete and quantifiable response to a specific research inquiry.

### 1.6.1 Target population

A target population is defined as the set of people regarding whom the investigator needs information in order to discover answers to the research questions, or those who are acceptable for inclusion in the research. (Bell, Bryman and Harley 2018: 46). The huge size of populations poses a challenge for researchers since it becomes impractical and costly to administer tests to every person within the population. In the Msunduzi Municipality (2020) database there are 142 registered SMEs in Msunduzi Municipality. The research focused on owners and management of small and medium-sized enterprises (SMEs) within the manufacturing industry situated in Pietermaritzburg, the principal city of KZN, South Africa.

### 1.6.2 Sampling method and sample size

According to Taherdoost (2016: 18-27), a sample refers to a subset of the target population from whom data is gathered. Considering the size of the SME population that is recorded in the database of the Msunduzi Municipality it was possible to employ census sampling. Thus, all 142 manufacturing SMEs on the Msunduzi Municipality database (2020) directory operating in Pietermaritzburg were invited to participate in the study.

### 1.6.3 Research instrument

The instrument of data collection was a questionnaire. The questionnaires were hand delivered by the researcher or sent via email,both. The questionnaire was designed after a literature review and in line with the research objectives. The questionnaire utilised Likert scales to make information easy to quantify using the Statistical Package for Social Science (SPSS) computer software version 29.0.1.

### 1.6.4 Pre-testing

Pre-testing is critical when conducting the measurable portion of a research study. In the current study the questions were put through a trustworthiness test. According to Berndt (2020: 224), pre-testing allows researchers to test research instruments on a significantly smaller research sample to see how respondents react before the actual investigation is completed. Questionnaires were distributed to ten business owners from SMEs in Pietermaritzburg. This testing was conducted to ensure that the research instrument was adequately prepared.

### 1.6.5 Data analysis

Data analysis is a systematic approach to examining and organising statistical information obtained from individuals who have responded to a survey or study. (Gentles *et al.* 2015: 1172). Statistical analyses were conducted using SPSS computer software version 29.0.1.. The questionnaires were sent to a professional and accredited statistician to analyse and interpret the data.

## 1.7 DELIMITATIONS

The study was confined to the registered manufacturing SMEs operating in Pietermaritzburg,KZN. The population did not include manufacturing SMEs which were not on the Msunduzi database (2020).

## 1.8 LIMITATIONS

The study only investigated SMEs in manufacturing industries in Pietermaritzburg,KZN. As a result, conclusions must be treated with discretion. All SMEs in Pietermaritzburg that were not registered with the Msunduzi database (2020) were excluded from the population.

## 1.9 VALIDITY AND RELIABILITY

Reliability refers to consistency through time, meaning that an investigation will produce similar findings when performed repeatedly in a comparable situation (Leedy, Ormrod, and Johnson 2019: 287; Gerrish and Lathlean 2015: 415). To improve the reliability of the instrument, internal consistency was ensured through cross-checking of the questionnaire by the supervisor and Faculty Research Committee members who are located in the Department of Finance and Information Management,Durban University of Technology (DUT).

## 1.10 ETHICAL CONSIDERATION AND CONFIDENTIALITY

This study's ethical considerations were consistent with those of DUT. These concerns were addressed by submitting to the supervisor and the Faculty Research Ethics Committee all relevant papers used to collect information. The ethics committee granted the ethical clearance. The information and responses obtained from participants were kept private. Personal information was sought from participants. Everyone who took part was taught the value of secrecy, ethics, and restrictions. Participants gave informed consent, and were informed that the data would be anonymous and would be protected from possible information leaks. When such items have completed their role, they will be destroyed.

## 1.11 OVERVIEW OF CHAPTERS

### Chapter 1: Introduction

This chapter contains an introduction as well as background information supporting the necessity of the study. The purpose of the study, the objectives of the investigation, and the research questions were discussed.

**Chapter 2: Literature Review**

This chapter provides an overview of all the literature from international and local studies on smart manufacturing and what factors influence innovative leadership in mobilising SMEs, as well as a clear insight into the threat and opportunities going forward.

**Chapter 3: Research Methodology**

This chapter presents the method used in this study and the logic behind the choice of research design. The study's research strategy and methodology are discussed in detail. The research strategy, demographics, sample, and data collection tools are discussed in connection with the study's aims and objectives.

**Chapter 4: Outcome and Findings of the Study**

A full description of the findings is matched with the study's aim and goals. This chapter discovers and examines additional relationships among research variables. Figures, charts, and tables are used to display the descriptive findings.

**Chapter 5: Summary, Conclusion, and Recommendation**

Conclusions and recommendations based on the research findings are discussed, as are the findings of an investigation into the factors influencing the adoption of innovative leadership for smart manufacturing in SMEs that could assist manufacturing SMEs in adopting innovative leadership.

## 1.12 SUMMARY

The first chapter provided the study's background, problem description, and defined the aim and objectives. Furthermore, the study's importance and methods were discussed. Finally, the chapter overview shows the research route of this dissertation. This chapter also discussed the relevance of this study. The dissertation's scope and organisation were also noted.

The following chapter presents the literature review and theoretical framework that underpin this investigation.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 INTRODUCTION

The previous chapter presented this study's introduction, a comprehensive overview of the study, a well-defined issue statement, a well-articulated goal, as well as the research objectives and research questions that guided the study. This chapter presents a review of relevant literature with an emphasis on factors influencing SME's adoption of innovative leadership for smart manufacturing. This chapter also provides an overview of the South African SME manufacturing sector and unpacks the smart manufacturing challenges facing the South African SME manufacturing sector. The benefits of adopting smart manufacturing by SMEs and the factors associated with smart manufacturing are also discussed. The chapter concludes by discussing the gap identified in the literature and the theoretical framework that was used in this study.

## 2.2 DEFINITIONS OF KEY TERMS USED IN THIS STUDY

As a point of depature, this section provides definitions of key concepts used in this study, namely, smart manufacturing, innovative leadership and SMEs.

### 2.2.1 Smart manufacturing

Smart manufacturing encapsulates a brand-new revolution within the manufacturing enterprise. Smart manufacturing is a nascent phenomenon that involves the incorporation of production assets from the fourth industrial revolution, together with sensors, computer platforms, communication technologies, management systems, simulation techniques, data-intensive modelling, and predictive engineering (Kusiak 2018: 516). Smart manufacturing is intended to maximise resource effectiveness and process efficiency in manufacturing through the use of information and communication technology (Sinsel 2020: 104). This study adopts the definition of smart manufacturing as articulated by Ritala and Almpanopoulou (2017: 41), as being a fully integrated, collaborative production system which ensures real-time adaptation to the needs of the plant, supplier network, and customers.

### 2.2.2 Innovative leadership

Innovative leadership is the method of promoting innovation by creating an initiative-friendly environment and establishing a plan of action that directs and increases trust among workers (Rahman 2018: 47). This type of leadership is vital for growing new products, supporting market competitiveness, and maintaining economic growth (Akkumol, Sikha and Kurian 2019: 34). An innovative leader's ability to discover and implement improvements is necessary to be able to adapt to constantly changing technology and consumer preferences, thereby enhancing worker creativity. According to Ngibe and Lekhanya (2019b: 17), innovation is more than just transforming an idea into a product; it must also be based on marketplace understanding and be a suitable management skill.

### 2.2.3 Small and medium-sized enterprises

According to Abdullrazak and Alyamani (2019:299), there is no one or universal benchmark that can be used to determine what makes an SME. Each country has its own version of this. However, some features, such as the number of full-time workers and/or yearly income or turnover, are used to assess the extent to which SMEs may be classified as such. According to Khumalo (2019: 44) SMEs are generally classified as businesses with fewer than 500 employees. The number of employees in SMEs varies by sector and depends on the size of the company (Grube, Malik, and Bilberg 2019: 127). The Small Enterprise Development Agency (SEDA) (2016: 17) states that SMEs are divided into employers and self-employed workers. An employer is an SME that hires one or more employees to execute their job, while an own account worker is the only owner of the firm who does not hire others.

According to SEDA (2016: 17), the total number of SMEs in South Africa in 2016 was 2 182 283. There were 795 428 (35.33%), with the remaining being self-employed. 9.1 million people are employed by SMEs. Construction accounted for 12% of SMEs, with manufacturing 9%, agriculture 3%, transportation and communication 7%, trade and accommodation 43%, and others 26% (SEDA, 2016: 17). Gauteng (30.6%) was the province with the highest proportion of SMEs, followed by KZN (14.4%), Limpopo (13.9%),Western Cape (11.8%), Mpumalanga (9.6%), the Eastern Cape (8.5%), North West (5.6%), Free State

(4.9%), and Northern Cape (0.7%). According to Ketschau (2017: 1545), 37.05% of SMEs hire 0–9 people, 12.88% hire 10–19 people, 15.21% hire 20–49 people, and 34.87% hire 50+ people.

## 2.3 AN OVERVIEW OF THE SME MANUFACTURING SECTOR IN SOUTH AFRICA

According to Sahoo and Yadav (2018: 1125), after apartheid, South Africa, like other emerging countries, suffered from economic challenges that required immediate action. A dramatically elevated rate of unemployment, a lack of skills, an elevated education rate, an ever-increasing level of criminal activity, and rural poverty are among the difficulties (Nguyen, 2016: 18). Manufacturing SMEs in the Republic of South Africa are diverse and engage in a variety of sectors, including retailing, wholesale, the tourism industry, agriculture, mining, manufacturing, building, and services. Manufacturing SMEs in South Africa, like those in other developing nations, experience constraints that limit their development and survival (Katambwe 2017: 748). In considering the important role of manufacturing SMEs in South Africa, it is critical to ensure they get enough attention and support (Bosselmann 2016: 43). The South African government recognises the value of robust and dynamic innovative manufacturing SMEs, as evidenced by its dedication to the creation and encouragement of manufacturing SMEs, which aims to increase the number of emerging firms while also establishing an enabling environment to assure their continued existence and development (Sinsel 2020: 44). The National Small Business Act of 1996 was designed to help the government attain such objectives. Manufacturing SMEs are regulated and supported under the National Small Business Act (102 of 1996).

The Act employs numerical criteria to classify business endeavours as very small, micro, medium, or small (Madanchian *et al* 2017: 1046). Total full-time paid personnel, total yearly turnover, and gross asset value are among the numerical parameters stated in terms of the Act's fundamental categorisation per industry (Ngibe 2020: 186). Manufacturing SMEs are generally more labour-intensive than larger businesses; on average, manufacturing SMEs generate greater possibilities for employment per unit of invested capital (Owalla 2019: 77). They serve as a vehicle for applying the skills, energy, and business ownership of individuals who are unable to reach their full potential in bigger companies. These entities play an important role in South Africa's economic growth, accounting for 41% to 42% of economic turnover in the country (SEDA 2018). The manufacturing SME sector employs between 6.9 and 8.1 million people in South Africa (Boon and Edler, 2018: 446).

## 2.4 SMART MANUFACTURING CHALLENGES FACING SMES IN SOUTH AFRICA

Despite the widely acknowledged benefits of SMEs for economic growth, entrepreneurship, and enhanced local technology, African small businesses have underperformed due to various challenges (Reis 2018: 89). SMEs in Africa face a plethora of challenges that limit their growth (Jane 2017: 2). This is reinforced by Sinsel (2020: 63) and Ritala and Almpanopoulou (2017: 42), who affirm that, in addition to their beneficial role in growth, SMEs face several challenges that restrict their long-term survival. In order to be successful, small companies need resources and services. Company owners and the government may be responsible for providing these resources. For years a lack of infrastructure has been regarded as an issue in Africa that has hindered economic development. Boshoff (2018: 64) points out that the state of the infrastructure has deteriorated, leaving areas undeveloped and disrupting the economy.

The smart manufacturing challenges facing SMEs in South Africa are explained in more detail below.

### 2.4.1 Skills shortage

Lichtenthaler (2016: 66) identified the skills shortage as a critical challenge that influences the performance, development, and increase of commercial enterprises as well as the quality of smart manufacturing. Thus, a shortage of skilled workers causes smart manufacturing SME firms to be less capable of competing in the market. Smart manufacturing SMEs that have appropriate skills and a well-educated workforce perform effectively (Cai, Huang, and Wang, 2017: 319). Walliman (2017: 44) further adds to the argument by highlighting that smart manufacturing companies with well-equipped human resource capabilities are by far the most effective.

### 2.4.2 Access to reliable information

Another difficulty that African smart manufacturing SMEs face is a lack of reliable business information from service providers as well as the government (Sitharam and Hogue 2016: 270). This issue stems from a deficient information environment resulting from undeveloped technology and communication infrastructure, together with insufficient business support (Jane 2017: 123). The provision of suitable technology and associated support networks, such as software and hardware, makes it easier for smart manufacturing companies to be practical and reliable, thus reducing operation costs and production costs. Governments and other bodies must take information and communication infrastructure into account if small and medium enterprises are to perform their crucial growth role (Bothof and van Weele 2018: 101).

### 2.4.3 Management's competency and capability

The lack of management expertise, skills, and knowledge, is a key problem for many SMEs. A supervisor's capacity to combine both internal and external materials to support skills that, when succeeded in, result in capabilities creates ability (Reis 2018: 89). Quartey *et al.* (2017: 26) identified a lack of creativity and leadership as major challenges affecting fully integrated, collaborative smart manufacturing SMEs in the areas of management and technical abilities. Sekhametsi (2017: 89) states that ineffective management is a major concern due to the fact that the majority of smart manufacturing SME operators or managers lack managerial competence, therefore most business owners' managerial practices are built on trial and error and are driven by performance and short-term profits with little consideration for the long-term since they lack the essential skills and expertise to operate their businesses (Muriithi 2017: 32; Jane (2017: 132).

Both developed and still-developing countries are plagued by the issue of poor management. Funieru (2016: 69) states that underdeveloped managerial and leadership abilities, as well as a general inability to implement best business practices in leadership, are limiting the growth and success of a large group of SMEs. Apart from that, the analysis revealed that crucial procedures, including formalised strategy implementation and several strategic human resource practices such as information exchange, involvement in decision-making, training, and worker cooperatives, were generally poorly managed (Zalk 2019: 44).

### 2.4.4 Access to financing

The expansion of fully integrated, collaborative smart manufacturing in Africa requires sufficient financial resources. A lack of funding has been recognised as a barrier to such growth (Woldie, Laurence and Thomas 2018: 50). Quartey *et al* (2017: 24) add that Smart manufacturing faces a generally recognised problem of lack of access to money or credit as the new technology machines are costly (Quartey *et al.* 2017: 33; Veliu and Manzhari 2017: 61). According to Berisha and Pula (2018: 1), Africa's financial systems are often not only small, shallow, and costly, but they also have a very restricted reach, serving just a small fraction of the total population. As a consequence, some smart manufacturing SMEs are compelled to finance themselves or depend on friends and co-workers for funding (Reis 2018: 89).

## 2.5 THE BENEFITS OF ADOPTING SMART MANUFACTURING BY SMES

Manufacturing has traditionally been defined as the conversion of raw material to a finished item by a process or a series of processes (Lei 2018: 18: 13). Smart manufacturing is a way of making industrial processes smarter and more connected, utilising a variety of technologies and solutions (Rahman 2018: 47). The adoption of smart manufacturing processes by SMEs enables these businesses to be more efficient, lucrative, and long-term viable (Owalla *et al* 2019: 98). Using these processes SMEs can tap into new and emerging markets by creating high-quality, low-cost, complicated, and customised goods (Ayandibu and Houghton 2017: 133).

Smart manufacturing has opened up new opportunities for meeting consumer demands. Table 2.1 depicts a smart manufacturing process diagram, which in turn illustrates some of the benefits of this innovation. Smart manufacturing technology can fundamentally disrupt the manufacturing sector, opening up opportunities for new competitors to arise and take control of brand-new industries (Lei 2018: 18).The South African industry is distinguished from competitors in more conventional, developed capital markets by its manufacturers, who are noted for being early adopters of new technology and ready to embrace better ways of doing business to maintain adaptability in an industry that is always changing (Funieru 2016: 166). Kusiak (2018: 513) further adds that the future of South Africa's economy, which is now precarious, depends heavily on the local manufacturing sector, and the accessibility of smart manufacturing systems might determine how successful we are in the area and globally in the future.

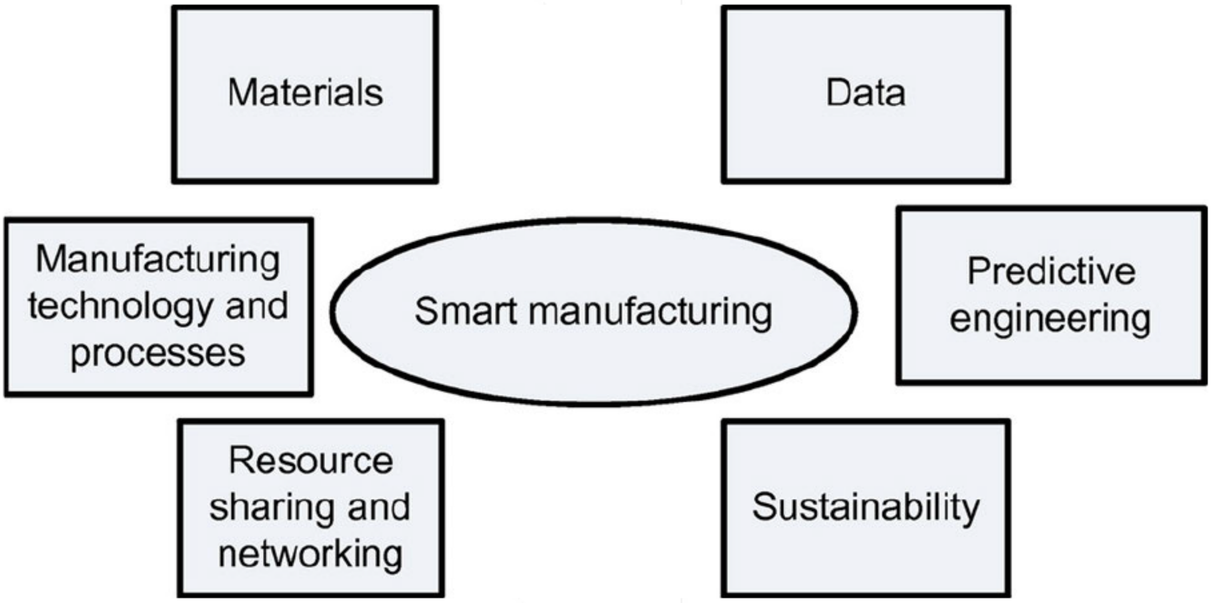


**Figure 2.1: Smart manufacturing process diagram**
Source: Sahoo and Yadav (2019)

### 2.5.1 Manufacturing technology and processes

Manufacturing is the process of producing products that consumers want to purchase (Khumalo 2019: 177). There are numerous approaches that a manufacturing organisation can utilise to produce goods in a fully integrated, collaborative manner (Aries *et al*. 2020: 765). A production system normally involves all the processes an establishment might undertake to establish production targets, manufacture and construct items, and distribute goods to the client. Companies may produce toys, hygiene products, industrial machinery, technical devices, and a wide range of other things (Pinto, Goncaives and Reis 2018: 41). In the process of manufacturing, employees and equipment work together in a fully integrated, collaborative manner to produce products that are unable to be divided into parts or disassembled. Generally, this industrial process transforms materials into compounds (Lekhanya, 2016: 20). The number of commodities produced during a single production run can be used to classify manufacturing processes.

### 2.5.2 Materials

Utilising smart manufacturing processes also translates to the adoption of smart materials, including organic-based biomaterials (Sekhametsi 2017: 89). This innovation, according to Ngibe and Lekhanya (2019b: 17-19), triggers the production of future goods. Using several new materials necessitates innovative procedures that must be created and incorporated into smart manufacturing, and this is a significant contributor to the quest for novel materials (Phuyal, Bista and Bista 2020: 20).

### 2.5.3 Data

Smart manufacturing is experiencing an expansion of data, triggered by the use of sensors, wireless devices, and advances in data analytics (Schein and Schein 2017: 17). Data is being collected from a broad range of sources including material characteristics and process parameters, and data from consumers and suppliers (Adamczyk, Szejka, and Canciglieri 2019: 13). Data is utilised to fuel any future smart manufacturing applications.

### 2.5.4 Predictive engineering

Predictive engineering is a recent development in the field of smart manufacturing solutions, which leads to an aggressive rather than a defensive organisation (Schein and Schein 2017: 101). Boshoff (2018: 84) states that predictive engineering provides a whole new approach to creating high-fidelity simulations (digital representations) of the phenomena of interest. These kinds of models enable the examination of possible future position some of which are within the range of present technology and others that are not yet developed (Ngibe and Lekhanya 2019a: 18). To help make judgements about future production and market circumstances, such broad-reaching models are helping to restructure the smart manufacturing industry.

### 2.5.5 Resource sharing and networking

Shared resource models are becoming more prevalent (Crane and Matten 2016: 13). These concepts are intended to benefit smart manufacturing by allowing it to share manufacturing equipment, software, expertise, and, most importantly, the interactive modelling and production environment (Schein and Schein 2017: 123). Much of this creativity and decision-making takes advantage of the digital environment as production becomes increasingly digital and virtual (Ayandibu and Houghton 2017: 138). This digital-physical separation will allow enterprises, even rivals, to share resources.

### 2.5.6 Sustainability

According to Bosselmann (2016: 97), smart manufacturing is influenced by sustainable product design and sustainable manufacturing processes using sustainable materials. There appears to be little dispute that the highest sustainability advantages are realised when processes or product development is guided by sustainability criteria (Masocha and Fatoki 2018: 1264).

### 2.5.7 Improvements in the value chain

Sekhametsi (2017: 89) states that smart manufacturing procedures improve network connectivity throughout the logistics chain. Data analytics enables the supplier to be adjust to orders more quickly which allows the manufacturer to order or manufacture what is required for what process when it is needed (Sinsel 2020: 104). Suppliers are able to fully integrate and collaborate by providing exactly what is required, eliminating waste and any delays caused by parts that are unavailable. Supervisors can recognise opportunities for innovative products or remake items of higher value by fully integrating and collaborating with clients (Kusiak 2016: 511).

### 2.5.8 Cost reduction

Schein and Schein (2017: 17) assert that as production increases, costs can be reduced, which may then be spent on product innovation. According to shivajee Singh and Rastogi (2019: 328), technological changes in manufacturing systems decrease the costs of manufacturing and improve machine productivity. The performance of an organisation can be evaluated and also improved on a cost basis and in the manufacturing process.

### 2.5.9 Increase in job opportunities

Smart manufacturing is attractive and helps to recruit a younger, more tech-savvy workforce (Sekhametsi 2017: 89). Employees may detect new possibilities and boost productivity by using smart manufacturing applications and data. Smart buildings, which may be needed for smart manufacturing, have the potential to increase employment by 2-4 times that of the existing national employed population (Vargas 2015: 18).

### 2.5.10 Product innovation

Product innovation is the method of creating a brand-new product or upgrading a current one in order to suit the needs of clients in fresh ways Abdullrazak and Alyamani (2019:295). Boshoff (2018: 89) asserts that a creative product could push beyond a stagnant industry and fulfil client wants in novel and fascinating ways. At its foundation, innovation allows firms to stay relevant and grow. It may be challenging for an organisation owner to foster creative thinking inside the company or firm, assess what innovation opportunities exist, and put them into action with his or her current skills (Ueasangkomsate and Jangkot 2017: 108).

## 2.6 FACTORS ASSOCIATED WITH SMART MANUFACTURING

While the previous sections highlighted the significance of smart manufacturing, it is equally important that factors associated with it be identified and discussed. Smart manufacturing is affected by various factors, as discussed below.

### 2.6.1 Political factors

The political climate impacts a company's decision on where and how to compete in the smart manufacturing market (Semuel, Siagian and Octavia (2017: 1155). A stable political climate makes investment in smart manufacturing processes and systems more appealing (Babbie 2017: 23). Therefore, smart manufacturing companies must be aware of political trends as this may lead to changes of policy. Political instability impacts market circumstances, which in turn affect consumer behaviour and the amount of aid and support that the government can provide to smart manufacturing companies Ritala and Almpanopoulou 2017: 39 ; Ingram 2017: 654).

### 2.6.2 Regulation/legal factors

Any country's government is responsible for establishing rules, legal structures, and processes that control how business is conducted inside its boundaries (Herald *et al.* 2020:2134). These regulations control the compliance requirements for smart manufacturing SMEs. As a result, they have major ramifications for the organisation's operations. According to the South African Revenue Services (SARS 2019: 1), paying taxes helps the economy grow, which improves the country's situation. According to Skinner, Smith, and Swanson (2018: 89), legal aspects include any law that affects a smart manufacturing company's operation, such as export restrictions, employee protection laws, workplace health and safety regulations, and competition rules. The political and legal environments are inextricably linked (Skinner, Smith, and Swanson 2018: 90). Reliable information is desperately required, and the government and industry groups should make excellent consulting services available to smart manufacturing SMEs.

Smart manufacturing SMEs are all subject to presumptive taxation, which entrepreneurs frequently refer to as "unrealistic taxes" since these can significantly impede the creation and expansion of their small enterprises, leading some to fail (Boshoff (2018: 89; Herald *et al.* 2020:2133). Tax compliance sets high expectations in terms of the processes that must be followed, such as understanding registration or payment laws (Bozdoanolu 2016: 179). Most smart manufacturing SMEs lack experience in tax affairs which raises the cost of tax compliance as a result of having to devote a large portion of their income to complying with tax rules. This limits the potential of smart manufacturing sector SMEs to be innovative and competitive (Kashalaba 2017: 18; Tee, Boadi and Opoku 2016: 119; Koranteng *et al.* 2017: 240; Inasius 2019: 367; Ngibe and Lekhanya 2019a: 10; Lekhanya, 2016: 16; Olla, 2016: 14). Not all SMEs in the smart manufacturing industry have the appropriate resources or are aware of the requirements to comply with onerous tax standards (Olla 2016: 14).

A European Central Bank (2017: 7) poll of European SMEs identified tax compliance and regulations as their most important concerns. Semuel, Siagian, and Octavia (2017: 1153)states that the two major obstacles limiting the innovativeness of manufacturing sector SMEs are a lack of skills and tax issues. As a result of variable tax rates that significantly damage their profit margins, the acquisition of SARS compliance certificates will remain a significant challenge for both new market entrants and current small and medium enterprises (SMEs) operating in the smart manufacturing sector. This challenge particularly affects their ability to achieve growth and promote innovation (Tee, Boadi and Opoku 2016: 120).

#### 2.6.2.1 Taxes

Muchimbidzi (2018: 3) posits that presumptive taxes are too costly for most growing SMEs, and many have collapsed as a consequence of neglecting the payment of taxes, with numerous more expected to follow. According to Kashalaba (2017: 18), the majority of SMEs lack tax expertise, which escalates the cost of complying with tax laws; as a consequence, the bulk of revenue is spent on submitting taxes and complying with tax regulations. Tax compliance requires procedures and tax requirements to be followed, such as precise registration or payment restrictions (Bozdoanolu, 2016: 16). In general, there are four types of tax compliance behaviours (Muchimbidzi 2018: 3), which are: timely and correct registration; timely filing or lodging of required taxation information; reporting of complete and accurate information; and timely payment of the proper amount of tax.

### 2.6.3 Level of education

Personal growth, creativity, self-reliance, and initiative-taking, as well as action orientation, are all concerns of education (Ndofirepi and Rambe 2018: 2). Education promotes the development of information, competencies, and experiences that enable entrepreneurs to increase their ability to sustain their firms (Ngibe and Lekhanya 2019b: 5). According to Lekhanya (2016: 20), the degree of education is critical to leadership innovation because it encourages deeper interaction with the enterprise's functional domains in smart manufacturing. According to Ngibe and Lekhanya (2019b: 5), the degree of education enhances competitiveness, productivity and growth while greatly boosting the entrepreneurial atmosphere. A substantial association was also found between opportunity-driven SME leadership in South Africa and educational level since the majority of early-stage entrepreneurs had a secondary degree. This is backed up by figures from the Trade and Industry Policy Strategies (2017: 7), which show that almost half of the formal smart manufacturing leadership have a higher degree of formal education. As a result, universities and the government must analyse and address different entrepreneurial education value chains, including content generation and delivery strategies and improve the subject's practical emphasis (Ndofirepi and Rambe 2018: 14). Developing effective innovative leadership through education is one of the driving forces for the future success of the smart manufacturing sector's SMEs, and evidence reveals that weak leadership and management abilities are significant contributors to the failure of SMEs (SEDA, 2016: 21).

### 2.6.4 Influence of education and training

Education and training serve as the foundational elements for SMEs operating in the field of smart manufacturing. These endeavours enable SMEs to flourish, acquire novel competencies, maintain their relevance within their respective domains, and, of utmost importance, enhance the standard of entrepreneurship within the smart manufacturing sector (Ho, Kang and Chan 2018: 6). Almost all policy experts agree that entrepreneurship education is one of the most significant policy tools for encouraging entrepreneurship (Vakili *et al.* 2016: 78). Education and training are critical to building an entrepreneurial culture in South Africa since they add to entrepreneurs' social capital as well as inventiveness and networking capacity (Musetsho and Lethoko 2017: 80).

Education and training are vital because they strengthen an individual's determination and tenacity to raise the creativity and action dimensions of entrepreneurial intention (Madanchian *et al* 2017: 1047). According to Ngibe and Lekhanya (2019a: 6), education and training equips entrepreneurs to be inventive individuals capable of taking risks, managing consequences, and learning from outcomes. Education can accelerate the nation's economic development and ultimately aid in the resolution of its socioeconomic challenges, particularly unemployment and low economic growth by increasing the number and quality of entrepreneurs entering an economy and promoting innovation and adequate nurturing (Albright 2017: 3; Gamede and Uleanya 2017: 1). The President of South Africa, Cyril Ramaphosa has also recognised and hailed the significance of entrepreneurial education, saying that it should be incorporated into the basic education school curriculum in order to promote more wealth (Malope 2017: 4).

Education is critical for developing SMEs' smart manufacturing capacity to generate ideas and innovate which would improve SMEs' smart manufacturing leadership, particularly in KZN's manufacturing sector (Vakili, Tahmasebi, Tahmasebi and Tahmasebi 2016: 79). Furthermore, education helps to maintain levels of entrepreneurial competency, which contributes to the organisation's long-term success (Tomy and Pardede 2018: 2). Education and training commitment broaden the entrepreneur's perspective and openness to improving business performance (Gamede and Uleanya 2017: 3). Due to the sector's complexity and dynamic environment, SMEs require further academic advancement and professional training development. This is backed by a study conducted by Rajaram (2017: 57) which found that smart manufacturing SME leadership requires training and skill development in order to accomplish the firm's long-term success. Rajaram (2017: 59) states that training, education, and assistance provided to SMEs in the smart manufacturing sector should be tailored to the needs of each particular company.a

### 2.6.5 Influencing of financing in smart manufacturing

Policymakers, researchers, and stakeholders have contested the financing of SMEs in the smart manufacturing sector, fuelled by the enormous economic development contribution of these SMEs across the world (Ayyagari *et al.* 2016: 34; Naude and Chiweshe 2017: 3). The determination of loan accessibility is based on demographic factors, including size, ownership structure, duration of existence, and financial turnover, alongside the specific sector within which it works (Mutoko and Kapunda 2017: 8; Sibanda, Hove-Sibanda, and Shava 2018: 5).

Despite the fact that SMEs in the smart manufacturing sector are recognised as key contributors to the economy's GDP and formal sector jobs, financial constraints continue to block and oppress SMEs' capacity to innovate and develop (The Banking Association South Africa 2017: 1). SEDA (2016: 23) and Sibanda, Hove-Sibanda and Shava (2018: 6) acknowledged the tremendous difficulties encountered by SMEs in smart manufacturing when trying to obtain funding and credit, particularly owing to financial institutions' unwillingness to participate in SMEs. The explanation for this unwillingness is that SMEs provide a considerable level of risk to lenders due to their limited asset base and inadequate capitalisation (Schmukler 2017: 8; United Nations Conference on Trade and Development 2018: 1). There is also a correlation between the inability to get funding and loans and the incapacity of businesses to formulate a meticulously crafted and extensively investigated loan application for financial institutions (Peprah 2016: 11; Snijders *et al.* 2016: 12). Furthermore, the failure of a firm to provide information on its assets, accounting records, creditworthiness, and financial performance has a negative impact on the willingness of financial institutions to engage in medium- and long-term investments (Mutoko and Kapunda 2017: 2).

The absence of adequate access to medium- or long-term loans is a significant obstacle for SMEs operating in the manufacturing sector who want to expand their operations and enterprises (Nyanzu and Quaidoo 2017: 16). A lack of financing and credit from banks affects a company's general health and ability to innovate. Own funding and retained earnings are insufficient to accomplish and sustain innovation that can provide an edge over competitors within smart manufacturing sector SMEs (Ombongi and Long 2018: 39).

The aforementioned concerns exert influence on the level of innovation and ultimate sustained prosperity of SMEs operating within the manufacturing industry (Eniola and Entebang 2016: 31). Albuquerque, Quirós, and Justino (2017: 279) observe that SMEs operating within the smart manufacturing sector have a stronger capacity for innovation, growth, and global market penetration when endowed with enhanced access to capital as compared to those facing financial constraints.

### 2.6.6 Effects of technical skills on innovation

According to Shabbir, Shariff and Shahzad (2016: 65), there is a research deficit in South Africa regarding entrepreneurial skills appropriate for smart manufacturing SME entrepreneurs. Several writers (e.g., Deakins, Bensemann and Battisti, 2019: 239) have expressed similar sentiments. Mamabolo, Kerrin, and Kele (2017: 2) state that an empirical study is urgently needed in the KZN environment.

Investing in entrepreneurial training and skill development promotes the ability to take initiative while also encouraging entrepreneurs to explore and exploit opportunities, make risky decisions in uncertain circumstances, and create the capacity to succeed (Nyanzu and Quaidoo 2017: 17). SME smart manufacturing technical skills involve a grasp of expertise in certain operations, including procedures, processes, and techniques in the business's area of operation Mamabolo, Kerrin and Kele (2017: 3). Industry-specific IT, quality-monitoring abilities, as well as production development and operations management, are all essential to managing and operating business-related duties (Panigrahi 2016: 238). These are technical abilities required for manufacturing SME operations since they serve as a pivot for expansion (Ikupolati *et al.* 2017: 3).

According to Bentinck (2017: 1), entrepreneurs with technological skills have several benefits since they can readily manage the problems and possibilities that come with globalisation. Furthermore, technological skills serve as a support framework throughout the creation and realisation of a firm's vision and goal. It is obvious that without technical skills, innovative leaders will find their job becoming increasingly difficult (Professional Development Centre 2016: 1) because technical skills enable leaders to be innovative in the use of various machines and tools, as well understanding the application of the methods and approaches required to optimise operational efficiency. According to Jane (2017: 2), having technical skills relieves the strain of being dependent on others while also saving money and time. A study by Ngibe and Lekhanya (2019a: 2) backs this up, with the findings indicating that technical skills are the most important determinant in the success of SMEs in South Africa. According to Leg-Tero (2016: 1), a significant proportion, namely 65%, of small and medium-sized enterprises

(SMEs) experience inefficiencies in terms of both time and financial resources due to a deficiency in technological competencies. This deficiency encompasses an inability to fully adopt and use technology in their operations.

### 2.6.7 Organisation technology

A smart manufacturing company's tactics are crucial in making the transition from the traditional approach to doing things to a digitally enhanced technique (Bilge and Severengiz 2019: 731). Temel and Ayaz (2019: 526) further argue that a smart manufacturing company has to carefully consider its business plan to see if it will work throughout the transformation or if a whole new one needs to be developed (Bilge and Severengiz 2019: 728). A smooth transition process requires that the technological transformation programme be alignbed with the business model. According to Santos and Martinho (2020: 1033), it is challenging to pinpoint the precise relationship between the organisation's regular strategy and the approach used when it begins its technological transition.

## 2.7 THE CONCEPT OF INNOVATIVE LEADERSHIP

Innovation is the act of engaging in activities that deviate from the ordinary or conventional (Alharbi 2021: 214). Innovasion is a way of looking beyond the present to the future, a way of thinking beyond the present and into the future. When used effectively, innovation can be a technique, method, or control mechanism for organisations (Ritala and Almpanopoulou 2017: 40). At its most fundamental, innovation is the act of inventing and combining thoughts in order to connect present successes and prior research in order to address a future problem. It is generally associated with technical breakthroughs and has a big influence on the global economy (Rahman 2018: 40). Innovation provides a competitive advantage over competitors.

In the business world, innovation is critical since it helps organisations create income while remaining competitive. There is a link between innovation, jobs, money, and general living standards (Sayal 2017: 32). New goods, substances, techniques, and services are attractive ways for innovators to collaborate.

Leadership in SMEs may be challenging, requiring a leader with leadership qualities to enable the company's growth and, most importantly, to adapt to and change with internal and external challenges (Seth 2017: 1179). According to Vakili *et al*. (2016: 81), leadership attributes include the ability to think creatively and strategically, as well as to assure corporate development and sustainable growth. For the benefit of the company and themselves, management that exhibits transformational leadership qualities must be able to bring out the best in their employees. According to Lecuna, Cohen and Chavez (2016: 153), modern thinking and researching options are important leadership skills that influence long-term corporate performance. Management can be defined as a strategy of influencing and leading people in order to achieve corporate goals.

First, directly link innovation to senior executives' strategic planning objectives. Second, promote the creation of active innovation networks. Chief executive officers (CEOs) can make use of the present (and mainly undiscovered) potential for innovation without needing to implement radical reform programmes. Third, businesses can take active steps to create an innovative culture based on employee performance. Employees in such an atmosphere recognise that their ideas are valued, believe that it is safe to express those views, and work together with their management to control risk. According to Kahle *et al.* (2020: 44), most corporate management does not promote or practise innovative behaviour.

## 2.8 THE INNOVATIVE LEADERSHIP PROCESS

Despite extensive scholarly inquiry into the subject of leadership, it continues to be inadequately understood (Ghobakhloo, 2018: 914). The concept of leadership has been conceptualised as a complex interplay between the attributes of individuals, groups, and the surrounding environment (Alharbi 2021: 214). Leadership may be described as a strategic approach aimed at successfully influencing people to comprehend and concur on necessary actions while also enhancing individual and collective endeavours towards achieving a shared goal within an organisation or society. Alternatives to the command and control form of traditional leadership have emerged, including revolutionary leadership, inspirational leadership, self-leadership, visionary leadership, and democratic leadership (Müller, 2019: 1127). Strategic leadership is the systematic approach of establishing a shared vision, analysing both external and internal circumstances, and formulating and implementing leadership strategies to effectively tackle problems and fulfil the requirements of individuals within an organisation or country (Granstrand and Holgersson 2020: 3). Within the framework of this paradigm, innovative leadership may be conceptualised as the systematic undertaking of transformative initiatives, characterised by the introduction of novel ideas or approaches, with the aim of effectively addressing multifaceted challenges of a political, economic, social, technological, and environmental nature, in order to fulfil the needs and expectations of individuals. An innovative leader is characterised by their ability to effectively make significant and transformative changes (Santos and Martinho 2020: 1027).

Innovative leaders study history, evaluate the present, predict the coming years, and create a vision for changing and constructing new political, economic, social, and technological situations in organisations and nations to solve current and predicted future difficulties and satisfy people's expectations (Kahle *et al*. 2020: 23). They are adamant that with a shared vision they are able to develop a better tomorrow, which is why they are prepared to act courageously and take risks to do so. Shared visions express our underlying beliefs while also manifesting our profound aspirations, objectives, and dreams to achieve great things. Shared visions assist in focusing attention, deciding direction, encouraging and uniting individuals in a common goal. Certain innovative leaders engage in the overthrow of governments as a means to address present and future difficulties via the reformation and modification of existing structures, with the aim of attaining a shared objective (Müller 2019: 1129). Reformists and revolutionary leaders are dynamic individuals who possess the ability to effect significant transformations within certain sectors of a comprehensive system through the implementation of dramatic changes (Musetsho and Lethoko 2017: 74).Innovative leaders share characteristics such as knowledge, skills, beliefs, abilities, and leadership ambitions, all of which contribute significantly to the success of their innovative leadership practices and the success of followers is significantly influenced by a combination of their inherent traits as well as many internal and external factors (Müller 2019: 1132).

## 2.9 KEY FACTORS OF SUCCESSFUL INNOVATIVE LEADERSHIP

Human resources, systems, organisational materials, and structures are all factors that influence innovative leadership (Alshura and Al Assuli 2017: 08). A company's ability to compete is rooted in its leaders' education, which is associated with confidence, entrepreneurial skills, problem-solving abilities, discipline, drive, self-awareness, and behaviour that allow them to become aware of market opportunities and gather the resources required to set up the enterprise (Owalla 2019: 98). The lack of available skills is a significant obstacle to innovative leadership, and the crisis in the labour market has an effect on the general performance, advancement, and development of industrial organisations, in addition to the quality of manufactured goods (Alsolami, Cheng, and Twalh, 2016: 38). Martinez-Roman and Romero (2017: 561) highlight the fact that the lack of a trained workforce is a serious problem since it thwarts the efforts of manufacturing SMEs to innovate and enhance their processes.

Smart manufacturing enterprises operate in an external environment with limits that affect their well-being in many ways, such as intense rivalry within the same organisation and location. Because SMEs work with limited assets. According to Pallegedara (2017: 64), the concept of survival is implicated. The acquisition of suitable financial resources is vital for the development of a company. Based on the research conducted by Adebayo, Alheety and Yusoff (2019: 49), a lack of funds and limited access to funding are impediments to innovative companies and have a negative influence. According to Ayandibu and Houghton (2017: 134), elements impacting innovative leadership may include organisational conditions that are primarily beyond the company's control, such as human resources, systems, organisational materials, and structures. Alshura and Al Assuli (2017) state that the capacity of a firm to compete is founded in its leaders' education, which is connected to the confidence, skills, problem-solving ability, focus, motivation, personality, and behaviour of entrepreneurs.

Talent scarcity is a major problem for innovative leadership. Additionally, the disaster in the labour market has an impact on the overall performance, improvement, and development of industrial organisations, as well as the quality of manufactured goods (Owalla 2019: 98; Alsolami, Cheng and Twalh 2016: 35).

A lack of trained staff is a significant problem since it impedes the growth of manufacturing SMEs and prevents them from innovating new products (Martinez-Roman and Romero 2017: 543).

Smart manufacturing enterprises operate in a diametrically opposed external environment, with constraints affecting their well-being in a variety of ways, such as competition within the same company and area. Because SMEs work with limited resources, being small has a detrimental impact on survival (Pallegedara 2017: 40). The selection of proper economic resources is crucial for the growth of a corporation. The section below further discusses some of the factors influencing innovative leadership adoption in smart manufacuring enteprises.

### 2.9.1 Socio-cultural conditions

Socio-cultural have an impact on innovative leadership as well and Sociocultural elements are crucial in determining social growth and functioning , Sociocultural circumstances are the social and cultural elements that influence people's attitudes, beliefs, behaviours, preferences, conventions, and ways of life. Demographics are data regarding a certain population Semuel, Siagian and Octavia 2017: 1153). Societal cultural orientation has a significant influence on environmental goodwill, which passively benefits smart manufacturing SMEs (Russmann *et al*. 2016: 68). Ngibe and Lekhanya (2019b: 17) argue that entrepreneurs are increasingly prioritising social components in their pursuit of a competitive edge, hence driving successful innovation .

### 2.9.2 Competitive concentration

Competitive concentration, as well as market movements and tactics have an impact (whether positive or negative) on the entrepreneurial process (Taiwo, Ayodeji and Yusuf 2018: 18-22). As a result, knowing the role of competition and counter-opposition intelligence and movements is vital for the future of an SME (Mittal *et al*. 2018:52).

### 2.9.3 Lack of government financial assistance

According to Hofmann and Rüsch (2017: 27), smart manufacturing SMEs face many challenges in obtaining government funding. Smart manufacturing SMEs struggle to obtain funding from financial institutions due to the entrepreneurs' inability to prepare the process improvement documentation that financial institutions require. According to Ngibe (2020: 186), a lack of government financial assistance has been identified as a major factor influencing innovative leadership in academic evidence. Ngibe (2020: 88) argues that many academics have investigated government financing in the hopes of persuading the government and policymakers to reconsider the goals of funding procedures and the supply of financial incentives to small enterprises.

### 2.9.4 Lack of educated and skilled employees

Reis (2018: 89) asserts that one of the primary variables influencing business innovation is a lack of staff support and education. Research conducted by the SEDA (2016), educated and informed employees are more likely to succeed than uneducated or under-skilled individuals in smart manufacturing SMEs. The findings corroborate previous research by Kahle *et al.* (2020: 46: 33). Results of a recent poll show that manufacturing SMEs that are serious about business innovation and success must invest in employee capacity (Sahoo and Yadav 2018: 1125). Reis (2018: 105) argues that in order to attain innovation and sustain long-term development, SMEs operating in the manufacturing sector need to acquire skills and training.

## 2.10 THEORETICAL FRAMEWORK

Leadership complexity theory, diffusion of innovation theory (DIT), technology acceptance model (TAM)and complexity leadership theory were employed as a theoretical framework in the present research, supported by resource-based perspective theory. Complexity leadership theory is a response to the desire for a new leadership strategy from a system viewpoint that takes into account the complex interrelationships in the organisation as a result of conventional leadership's failure to suit the requirements of modern organisations (Baltaci and Balci 2017: 30; Turner and Baker 2017: 2). By adopting a perspective that recognises organisations as complex systems, leaders can effectively cultivate innovative leadership. This approach allows leaders to develop a strategic and systemic framework for fostering innovation. Consequently, this framework serves as a valuable tool for guiding behavioural changes that contribute to enhanced performance, such as the implementation of smart manufacturing practices (Turner and Baker, 2017: 2).

Complexity leadership theory advocates for the adoption of a complex adaptive system, which in turn emphasises the integration of leadership conduct and organisational results as a means to comprehend innovation. This is essentially about the interconnectedness of an organisation's functional resources (Baltaci and Balci, 2017: 31). According to Isichei *et al.* (2022: 2791), the establishment of strong connections between leaders and workers within an organisation facilitates a thorough comprehension of potential deviations in conduct that might hinder the achievement of organisational goals. Consequently, this knowledge renders the use of force unnecessary. The present theory explains what factors influence, which behavioural variations are embraced, and how they translate to improved performance.

In analysing factors affecting the adoption of the smart manufacturing processes by manufacturing SMEs, this study used a hybrid method by integrating the DIT and TAM ideas. TAM has been extensively used in exchange adoption studies and has been demonstrated to be able to explain characters acceptance of information technology (Turner and Baker, 2017: 2; Anderson, Potocnik, and Zhou 2014: 1317). Therefore, the adoption of smart manufacturing processes by SMEs is explained by the use of TAM. Although TAM is widely used to describe the successful adoption of innovations, it is unclear if it adequately describes the adoption of technological tools. To better comprehend the quick changes in information, some research has proposed merging TAM with other theories, most notably DIT (Leedy, Ormrod, and Johnson 2019:68). People will accept new ideas when they feel they will be more beneficial, like enhancing efficiency and effectiveness.

Abdullrazak and Alyamani (2019: 301). suggest using DIT to explain factors influencing innovative leadership and smart manufacturing processes. DIT is thought to be beneficial in gaining knowledge of particular innovation traits and is likewise beneficial in explaining why users undertake the innovation (Lei 2018: 20). DIT is a comprehensive social-psychological theory that aims to predict humans' adoption of new inventions via the identification of adoption behaviours and an understanding of their organisational aspects (Yildirm and Demirba 2020: 45). DIT includes additional particular aspects of an invention that may be used to explain why people embrace the innovation or how they make a choice to adopt it. Therefore, DIT was used in this study to link innovative leadership adoption by smart manufacturing in SMEs.

## 2.11 SUMMARY

This chapter presented a literature review pertinent to this study, with an emphasis on variables impacting small and medium-sized firms' adoption of innovative leadership for smart manufacturing. This chapter provided an overview of the SME manufacturing industry in South Africa. Furthermore, this chapter has discussed the smart manufacturing problems that the South African SME manufacturing industry is experiencing as well as the characteristics associated with innovative leadership. The benefits of smart manufacturing adoption by SMEs, as well as the features associated with smart manufacturing, were also explored, as was the importance of innovative leadership in smart manufacturing adoption. The chapter finished by discussing the theoretical framework employed in this study.The following chapter details the research methodology underpinning this research.

# CHAPTER 3: RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

The previous chapter provided the literature review and conceptual framework pertaining to the factors that influence the adoption of innovative leadership for smart manufacturing by small and medium firms. This chapter provides an overview of the research technique and research strategy used in the present investigation. The chapter begins with an examination of the research design, afterwards followed by intended population and an explanation of the data collection instrument used. The chapter describes the data analysis techniques that were used, as well as the ethical issues that were taken into account. Finally, study's limits, delimitations, reliability, and validity are presented.

## 3.2 RESEARCH DESIGN

Sekaran and Bougie (2016: 95) provide a definition of research as a systematic undertaking that encompasses both subjective and objective approaches, aiming to gather scientific data pertaining to a particular topic, independent of the researcher's own opinions. A research design also provides a framework for how the research study will be carried out by establishing standards for data gathering as well as for solving the problem at hand (Merriam and Tisdell 2015: 68).

According to Sekaran and Bougie (2016: 95), the purpose of carrying out a research study is to be able to gather data and transform it into meaningful facts that can then be viewed as information via an analytical process. To address the research challenge, it is necessary to provide a comprehensive response. The present study started by identifying the research topic in Chapter 1 and then substantiating it via a comprehensive examination of relevant literature. This literature review provided empirical support for the many elements that exert an influence on the adoption of innovative leadership within the context of smart manufacturing by small and medium firms. In order to assure the achievement of the study’s objectives, the researcher took measures to ensure that the research methodologies and approaches used in this study were in accordance with the requirements of the study.

In this particular study, the quantitative research approach was applied. This method is suitable for this study since the research objectives are measured using statistics that use numerical estimates and through comparing, describing, and connecting features (Khumalo 2019: 38). The objective was to provide a concrete and quantifiable response to a specific research inquiry (Bell, Bryman and Harley 2018: 27). Figure 3.1 provides a detailed overview of the methodology deployed in this study.


**Figure 3.1: Overview of the research methodology deployed in the study**

Figure 3.1 show the guidelines that were followed by the researcher in constructing the research methodology chapter. The full discussion of the research methods deployed in the study are explained in detail below.

### 3.2.1 Descriptive research design

The purpose of employing descriptive analysis is to determine whether or not the variables involved in the study are connected to one another (Sekaran and Bougie 2016: 6). Fisher and Bloomfield (2019: 22) define descriptive research as a method for describing variables rather than focusing on how the phenomenon occurred. The goal of descriptive research is to observe, describe, and document the characteristics of a scenario as they occur naturally (Leedy and Ormrod 2019:

67). Descriptive research is utilised to collect data that makes pronouncements about persons, events, or circumstances (Saunders, Lewis and Thornhill 2016: 416), and use the data to build a theory, identify existing difficulties encountered in practice, justify current behaviour, make judgements, or determine what others are doing in comparable situations (Fisher and Bloomfield 2019: 28). Descriptive analysis can be employed in quantitative or qualitative investigations (Fisher and Bloomfield 2019: 23). Through using descriptive analysis the researcher was able to identify and group factors that had a common influence in this study i.e. to compare variables and discover the aspects that were relevant to the study (Leedy and Ormrod 2019: 69; Farrelly *et al.* 2017: 24; Fisher and Bloomfield 2019: 25). Descriptive analysis uses tables, mean, standard deviation, frequencies, graphs, and percentages to describe the study's findings. In this study, the following descriptive analytic approaches were used:

The primary objective of this study was to ascertain the elements that have influenced on adoption of innovative leadership for smart manufacturing by small and medium-sized businesses in Pietermaritzburg. This was accomplished by examining the responses of the owners/managers/other key stakeholders regarding the innovative leadership demonstrated in their respective firms. The relationship between those factors was descriptive in nature. The researcher discusses the many factors that influenced business owners/managers/other stakeholders to adopt innovative leadership in their organisations.

### 3.2.2 Research methodology

According to Leedy and Ormrod (2019: 74), research methodology is the act of collecting data in order to make meaningful sense of it and draw conclusions about what is perceived or modifies what is known. Research methodology aims to generate information and comprehension of social or physical phenomena through a thorough search process (Farrelly *et al.* 2017: 44). Rubin and Babbie (2016: 34) add that research methodology is the total strategy incorporating the theoretical framework or paradigm. The most prevalent sort of research used by organisations is that which is targeted at addressing present problems or creating new bodies of knowledge, and these approaches are known as applied research or fundamental research (Leedy and Ormrod 2019: 74). The procedures used to find facts might be quantitative, qualitative, or a combination of the two. The procedure serves as an agent, assisting the researcher in providing relevant knowledge that is both instructive and adequate to influence a choice (Sekaran and Bougie 2016: 6). A quantitative technique was utilised in this study to identify variables impacting the adoption of innovative leadership for smart manufacturing by small and medium firms in Pietermaritzburg.

Quantitative research employs quantifiable data to statistically validate discoveries that add to the corpus of knowledge (Gog 2015: 45). A quantitative technique allows a researcher to address the phenomenon in terms of values that can be statistically analysed using statistics or models(Etikan and Bala 2017: 49). Quantitative data includes statistics that employ numerical estimations (Bell, Bryman and Harley 2018: 40) which compare, describe, and link characteristics (Leedy and Ormrod 2019: 70: 69). A quantitative research method, in a larger sense, is empirical research concentrating on a social phenomenon – in this case, the factors influencing the adoption of innovative leadership for smart manufacturing by SMEs (Sekaran and Bougie 2016: 23).

### 3.3 TARGET POPULATION

The phrase "population" describes the comprehensive collection of individuals, objects, or experiences that the researcher intends to investigate (Sekaran and Bougie 2016: 80). According to the Msunduzi Municipality 2020 database (Msunduzi Municipality 2020) there are 142 registered SMEs in Msunduzi Municipality. The research focused on proprietors and executives of SMEs within the manufacturing industry situated in Pietermaritzburg, the capital city ofKZN.

### 3.4 SAMPLING AND SAMPLE SIZE

A sample refers to a particular group of individuals selected from the larger target population from whom data was gathered (Taherdoost 2016: 18-27). Sampling is one of the most significant components of the research process since it informs the quality of conclusions drawn from the researcher's findings (Rajkoomar 2015: 83). Sampling refers to the procedure of selecting a sufficient number of members from a particular population or group that has been predetermined by the researcher to be representative of that population (Taherdoost 2016: 20).

Considering the size of the population on the Msunduzi Municipality datase, this study employed census sampling which is a type of probability sampling. Census sampling is a method of statistical enumeration where all members of the population form part of the study in order to provide adequate information on the population as a whole (Berndt, 2020: 225). The census method was adapted in order to cover or give all manufacturing SMEs population  in 2020 Msunduzi database a chance to participate in this research. Thus, all 142 manufacturing SMEs on the Msunduzi Municipality Data Base (2020) were included however only 103 who were interested in participating out of all 142 manufacturing SMEs on the Msunduzi Municipality Data Base (2020) population.

The sample frame chosen was centred on the precise attributes necessary (Sekaran and Bougie 2016: 280). The researcher chose only the owners, managers, and other relevant decision-makers of the smart manufacturing SMEs who fitted the criteria. Thus, the subjects were carefully chosen for their unique knowledge and exposure to the issue under examination. By using this technique, the researcher was able to gain a thorough insight into the participants' first-hand experiences with innovative leadership adoption as well as regarding what factors motivated them to adopt innovative leadership in their smart manufacturing SMEs. In this way, the researcher successfully minimised the time and financial resources required for the research by employing a purposive sampling method.

## 3.5 DATA COLLECTION

Data collection is the systematic procedure of acquiring information that will help the researcher solve the problem highlighted in the study (Berndt 2020: 226). Data falls into one of two categories: main or secondary data ( Rehman and Alharthi 2016: 51). Primary data are observations or interviews. Secondary data encompasses a wide range of pre-existing sources, including but not limited to conferences, textbooks academic sources include a wide range of materials, including journal articles, newspapers, reports, theses and dissertations, government documents, and websites. The main aim of the data collection method isto get real-time data from participants (Etikan and Bala 2017: 49). To get primary data, the researcher sent questionnaires and electronic communication to a heterogeneous cohort of owners and managers. This survey included 142 manufacturing SMEs, but only 103 participated. The questionnaires were distributed by the researcher to these targeted participants in their industrial enterprises in the Pietermaritzburg area.

### 3.5.1 Questionnaire research instrument

The method used for data gathering consisted of a questionnaire. A questionnaire is a research tool used to aid in the data collection process during a survey (Saunders *et al.* 2018: 1897), and is commonly used by researchers to collect data from a specific population relevant to the study (Sekaren and Bougie 2016: 197). Questionnaires are scientifically structured to ask pre-defined questions to each respondent in the same order (Saunders, Lewis and Thornhill (2016: 416). However, there are several approaches to gathering information with this instrument, including mailed surveys, human interactions with respondents, and telephone surveys (Brace 2018: 6). In this study, the researcher employed both human interaction and mailed surveys to expedite data collection and obtain information from respondents who were most conveniently accessible. About 85% of the questionnaires were hand delivered and 15% were sent via email, and all participants were called and asked to choose between the email or hand delivered option since most of the participants needed some clarity before they participated. The questionnaire employed a five-point Likert scale to ensure that the questions were direct and elicited the level of agreement felt by each respondent. They were closed-ended inquiries. The Likert scale had five options: strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). This was done to assess the various preferences of individual respondents (Brace 2018: 06). A Likert scale assesses the strength of respondents' attitudes about the subject being investigated in the study (Saunders, Lewis, and Thornhill, 2016: 416).

### 3.5.2 Design and layout of the questionnaires

According to Bell, Bryman and Harley (2018:), the form of a questionnaire requires significant attention from the researcher. This can take a long time and requires a lot of skill. Gravetter and Forzano (2015: 386) recommend that the format of a questionnaire include simple language and well-organised, easy-to-follow questions. Furthermore, a questionnaire should be organised logically, beginning with basic questions and progressing to particular questions in a clear and logical sequence. The researcher collected data from SME owners and managers using a single questionnaire. The study did not include any open-ended questions; instead, participants were provided with closed-ended questions. The individuals were provided with a range of predetermined responses to choose from. The subject matter was partitioned into five distinct sections.

**Section A**: This section examined the background information of the SMEs Owners and Managers through three questions designed to understand the participants' age category, gender, age position, number of employee years in the firm, highest educational qualification, and annual turnover.

**Section B**: This part looked at the processes of smart manufacturing used by small and medium enterprises.

**Section C**: This section looked at the innovative leadership practices applied in manufacturing SMEs.

**Section D**: This section examines the factors that affect the adoption of smart manufacturing processes.

**Section E**: This part looked at the factors affecting the adoption of innovative leadership by SMEs pursuing smart manufacturing.

### 3.6 PRE-TESTING

Pre-testing has significant importance in the quantitative part of the investigation. When using a self-completed questionnaire, it is critical for a researcher to undertake a pilot study (Mahlahla 2018: 78) to ensure that respondents have no difficulty completing the questions. The questions were tested for reasonable trustworthiness. Berndt (2020: 226) states that pre-testing is beneficial as a preliminary assessment of the research instruments using a smaller sample size in order to evaluate participant responses prior to the commencement of the main study. Questionnaires were distributed to five SMEs employees who are not part of the population sample and five business owners at Pietermaritzburg who were not part of the population. No changes were recommended. Pre-testing was conducted to ensure that the research instrument was adequately prepared.

## 3.7 DATA ANALYSIS

Data information analysis is the methodical investigation and arrangement of statistics obtained from participants (Gentles *et al.* 2015: 1172). A statistical analysis was done using SPSS computer software version 29.0.1 through inferential and frequency analysis to determine the reliability and evaluation of innovative leadership in smart manufacturing. The data gathered from the field questionnaire enabled the researcher to establish data analysis procedures that could aid in interpreting the study's conclusions through various analytical tests. The questionnaires were sent to a professional and accredited statistician to analyse and interpret the results.

## 3.8 RELIABILITY AND VALIDITY

### 3.8.1 Reliability

Reliability pertains to the degree to which a measurement instrument consistently produces comparable outcomes when repeatedly administered to the same group of participants. This implies that if the researcher consistently gathers data from the specific sample under comparable and well-regulated circumstances, the result should remain consistent. The most common reliability test done is the Cronbach's coefficient alpha with a perfect score of 1.00 (Sekaran and Bougie 2016: 307). The Cronbach's coefficient alpha measures how each item correlates with the others, and the greater the Cronbach's Alpha, the greater the reliability. Etikan and Bala (2017: 49). argues that an acceptable coefficient is 0.60 or higher. For this study, the reliability statistics satisfied the acceptable coefficient at 0.865, as shown in Table 3.1.

**Table 3.1: Reliability statistics**

**Table 4.2: Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .865 | 39 |

### 3.8.2 Validity

Validity may be defined as the degree of accuracy with which a measure of an actual concept represents its true meaning (Sekaran and Bougie 2016: 262),. Pre-testing was conducted to confirm the questionnaire's content. The degree to which the questions were able to answer the questions that were meant to be addressed in the research is determined by using validity as a measure of accuracy. As previously stated, questionnaires were delivered to five SMEs workers who were not part of the population sample and five Pietermaritzburg business owners who were not part of the population.

## 3.9 ETHICAL CONSIDERATION AND CONFIDENTIALITY

According to Saunders, Lewis, and Thornhill (2019: 72), ethical consideration refers to research regulations or standards of conduct that are utilised to guarantee that the study does not cause damage, does not reveal sensitive information, and does not compel subjects to participate without their agreement. None of the study's research activities were carried out with the goal of causing injury or distress to the participants (Gravetter and Forzano 2015: 101). Because the subject of the research is sensitive, the researcher presented the participants with a letter of consent or permission. The permission letter expresses the participant's voluntary assent and describes the advantages of the research as well as the uncertainties involved (Johns 2016: 568). Gravetter and Forzano (2015: 101) emphasise the need for the researcher to adhere to the ethical standards of respect, responsibility, and honesty towards the study participants. This study's ethical considerations were consistent with those of the Durban University of Technology (DUT). These concerns were addressed by submitting to the supervisor and the Faculty Research Ethics Committee all relevant papers used to collect data. The ethics committee granted the ethical clearance. Each questionnaire was supported by an ethical clearance letter (see Appendix A) from the Durban University of Technology's Faculty Research Committee (FRC) (DUT). Before the commencement of the study, all participants were required to provide permission. Only once this consent was obtained was the questionnaire administered. All participants were reassured that none of their sensitive information would be made public since confidentiality is standard practice while doing research. Individuals who took part in the study could not be identified since they had to check an anonymity box on the permission form. This was done to protect the participants' personal information. Each participant received the questionnaire at their job and was promised privacy.

## 3.10 LIMITATIONS

This research only focused on SMEs operating within the manufacturing sector located in Pietermaritzburg,KZN. Hence, it is essential to use care when making generalisations. The research has generalisation limits, which means that the results and consequences remain structurally particular. As a result, its application to other circumstances of the same kind may not sound logical. Furthermore, because the study is based on personal observations and viewpoints, the dependability factor was fairly low, and repetition of the same study may not generate the same findings. All SMEs in Pietermaritzburg that are not registered with the Msunduzi Municipality’s database were excluded from the population.

## 3.11 SUMMARY

In this chapter, it is illustrated how the research was conducted, showing the method that was adopted to select participants, the method adopted to collect data, and the research approach. Considering the background and nature of this study, extracting and reviewing the literature to support the study as well as the quantitative research method, a quantitative data collection tool (questionnaire) was used to collect the data. The selected research methods for this study were carefully chosen for relevance, reliability, and validity.

The next chapter discusses the results derived from the data that was collected, coded, and analysed.

# CHAPTER 4: DATA ANALSIS AND INTERPRETATION

## 4.1 INTRODUCTION

The previous chapter provided an overview of the research methods used in this study. This chapter presents a comprehensive examination of the data analysis and offers a thorough explanation of the outcomes derived from the data gathering method. The results of this research are provided via descriptive analysis, using visual representations such as graphs and tables, as well as numerical summaries such as frequencies. The chapter starts with examining the biographical data, which is then followed by an analysis and discussion of the findings in accordance with the objectives.

- To determine smart manufacturing processes used by manufacturing SMEs in Pietermaritzburg.
- To analyse innovative leadership practices applied to manufacturing SMEs in Pietermaritzburg
- To identify factors that affect the adoption of smart manufacturing processes by SMEs in Pietermaritzburg.
- To establish factors affecting the adoption of innovative leadership by SMEs pursuing smart manufacturing in Pietermaritzburg.

## 4.2 RESPONSE RATE

According to the data shown in Table 4.1, a total of 142 individuals were selected to receive questionnaires. Out of these, 103 individuals provided responses, resulting in a response rate of 72.5%. This is seen as an appropriate rate of response since it was greater than 65%, which is regarded as significant in order for an analysis to be carried out (Sekaran and Bougie, 2016). Yousuf (2020: 120) adds that a response rate of 50% or more in a survey is considered excellent.

**Table 4.1: Response rate**

| Sample Size | Number of Responses | Number of Non-Responses | Response Rate percentage |
|---|---|---|---|
| **142** | **103** | **39** | **72.5%** |

## 4.3 DEMOGRAPHIC INFORMATION OF RESPONDENTS

This section focuses on the demographic data that was contained in Section A of the questionnaire. The analyses covered, amongst other things, gender, age, experience, and academic qualifications of respondents. This information was considered pivotal in order to demonstrate that data was collected from relevant respondents who would provide relevant information necessary for the study. This information was also used to address the current knowledge gap pertaining to the adoption of innovative leadership by smart SMEs in the Pietermaritzburg area.

### 4.3.1 Gender

Figure 4.1 shows that 40% of the participants were female and 60% were male. These results demonstrate that there was an unequal distribution of respondents because there was an unbalanced participation of males and females in this study. These data indicate that the research was not gender balanced, as it was dominated by males. Gender is unlikely to have an effect on the outcomes. This gap can be attributed to the fact that males dominate leadership and managerial roles in the smart manufacturing industry, despite the significance of female entrepreneurship.

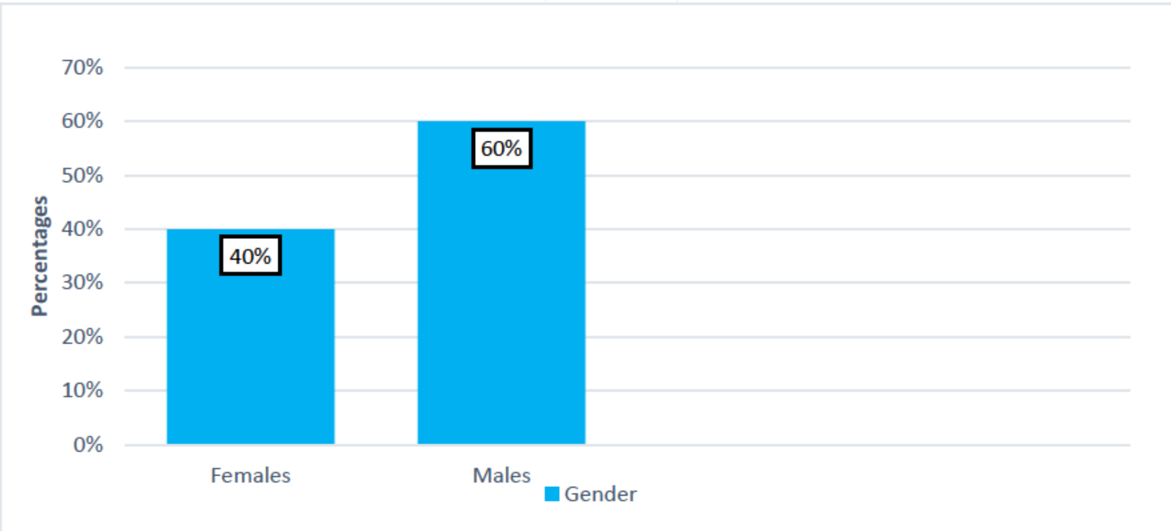


**Figure 4.1: Gender**

### 4.3.2 Age

The results in Figure 4.2 show that 10% of respondents represent the age category of 0–20 years, while 25% of respondents represent the age category of 21–30 years. In addition, 38% of the respondents were within 31-40 years age category and 27% were above 40 years. This seems to be in line with Msunduzi Municipality's working population statistics. According to STATS SA (2022), the average worker ranged between 20 and 65 years of age. The municipality's entire population has a gender makeup of 60% men and 40% women. Despite the fact that the number of males who participated in the survey was somewhat larger than the number of females, the gender and age distribution of the participants was as expected. Furthermore, the results demonstrate that this was a young adult-dominated study, with the majority of participants aged between 31 and 40 years.

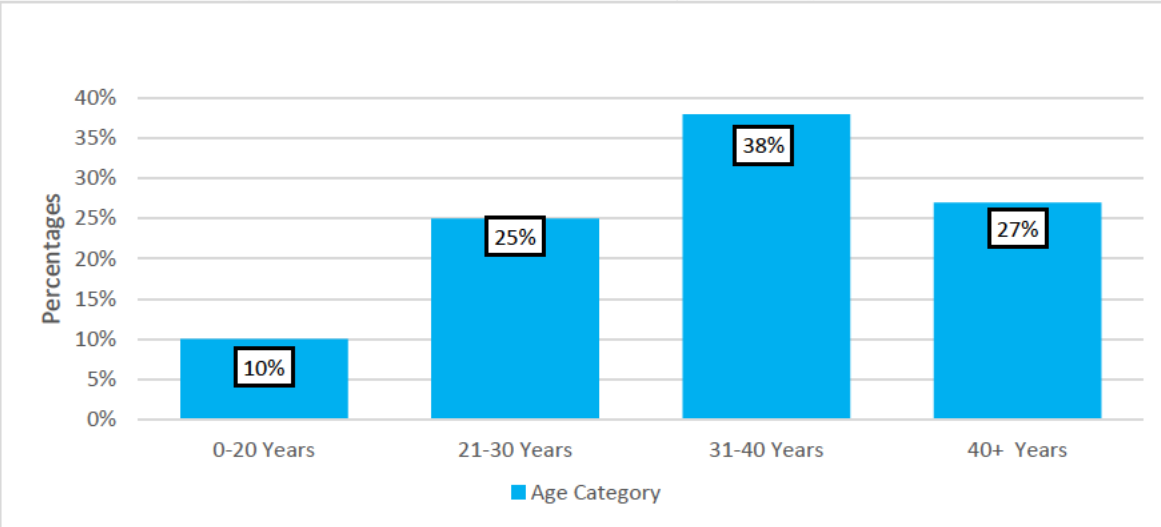


**Figure 4.2: Age**

### 4.3.3 Position in the business

The study's respondents were asked to indicate their position in the business in order to gain a better understanding of the respondents' position distribution. Figure 4.3 shows that there were 80% owners, or CEOs, and 20% managers. The majority of participants were business owners, which suggests that owners of SMEs were hands-on in their organisations. It can also be argued that they are all-rounders. Van der Heever and Van der Mervwe (2019: 10) management makes up a higher proportion of an organisation's entire workforce in SMEs. This clearly shows that the majority of manufacturing SMEs in Pietermaritzburg were managed by either owners or CEOs. This also demonstrates that the great majority of respondents possessed decision-making expertise.

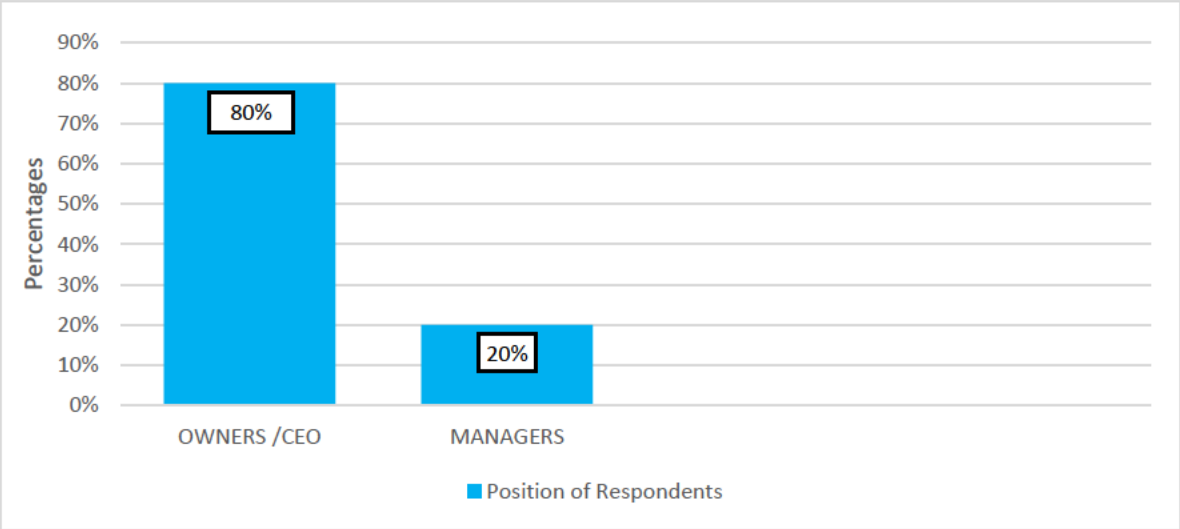


**Figure 4.3: Position in the business**

### 4.3.4 Number of years in business

Figure 4.4 shows that 9% of the respondents are still new in the industry since they have less than 5 years of operating experience. 10% of the businesses have been in operation for 5 to 10 years, while 72% of the respondents have been in operation for more than 10 years. This means that the respondents to the study have enough experience to give credible responses to the survey's questions. According to this data, the majority of respondents have been in operation for over 5 years and possess adequate experience to contribute significantly to this study.

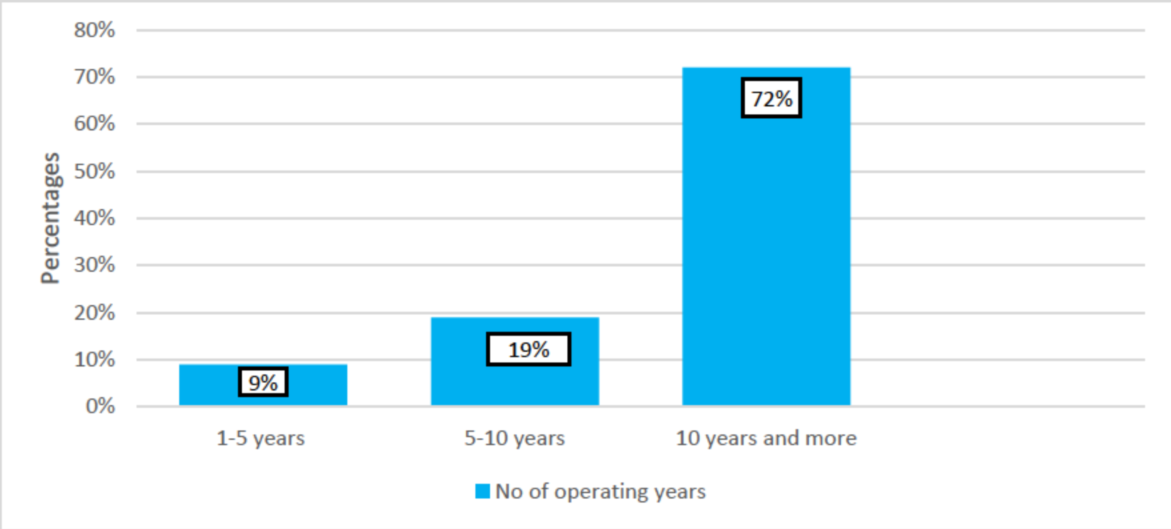


**Figure 4.4: Number of years in business**

### 4.3.5 Number of employees

As shown in Figure 4.5, in terms of the number of employees employed, 85% have 1–50 employees, while 10% have between 50–100 employees. Only 5% of enterprises had 100 or more employees. This is in line with the findings of Khumalo (2019: 44), who explained that SMEs vary widely across the globe and are generally classified as businesses with fewer than 500 employees. The number of employees has a significant influence on the business's sustainability and development. The proper quantity of management staff is very important for improved economic performance. As a result, it is critical to maintain a constant balance between necessary and available labour. The number of personnel participating in innovation activities is growing (Gryshova *et al.* 2019: 701). The majority of respondents show that SMEs number of employees is higher, with 85% from 1 to 50 employees; this means there is still a hindrance to growth in terms of employees, as the proportion of 100 and more employees is just 5%.

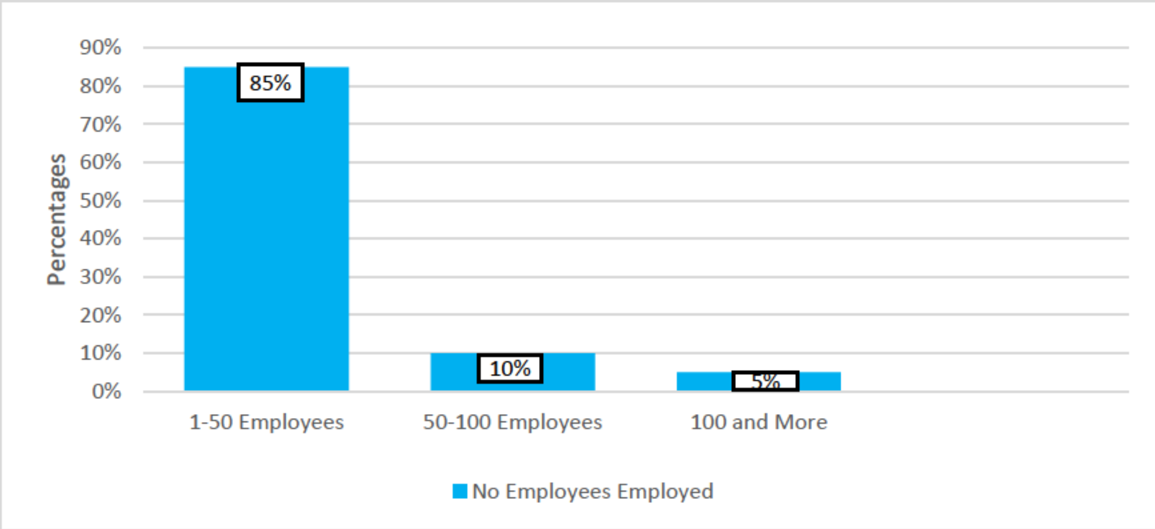


**Figure 4.5: Number of employees**

### 4.3.6 Educational qualifications

When asked about their educational qualifications, Figure 4.6 shows that most respondents had matric as their highest level of education, constituting 41% of the study population. This is followed by certificate holders, 31%. Diploma holders constituted 10%, while others had 12%, honours degree holders 4%, and master's degree holders 2%. This shows that the respondents may choose to further their education by earning an honours, master's, or doctoral degree, especially if they hope to perform better in their businesses in the future (Dang, Li, and Yang, 2018: 172). Innovative leadership towards smart manufacturing requires highly skilled leaders who possess relevant educational qualifications. These findings support Salazar's (2019: 93-94), who highlighted that small firm owners and managers lack formal business education.

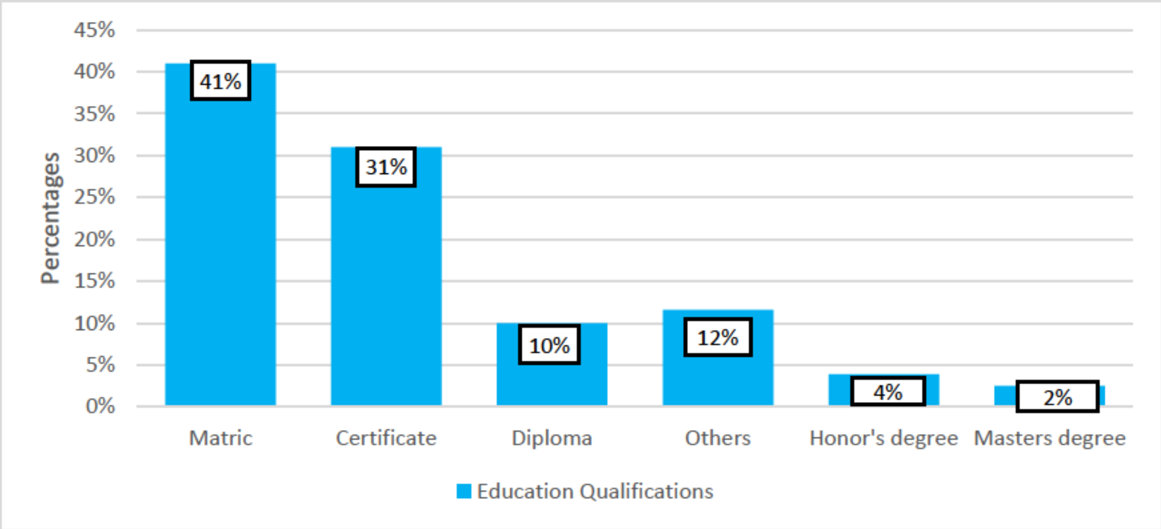


**Figure 4.6: Educational qualifications**

### 4.3.7 Annual turnover

As shown in Figure 4.7, 3% of the respondents had an annual turnover of between 1 and R200 000, 4% between R200 000 and R1 million, 9% between R1 million and R3 million, 4.20% between R3 million and R6 million, and 26% between R6 million and R13 million,and 42% R13 million or more. The results show that the majority of the participants operate businesses that have an annual turnover of over a million rand. According to these findings, the majority of the respondents owned medium-sized enterprises. One of the parameters used to determine the size of a firm is turnover. The reduced turnover indicates that these SMEs' market size was modest, which may have resulted in poor revenue generation. According to the findings, all of the targeted respondents satisfied the standards and definition of SMEs in South Africa based on turnover.

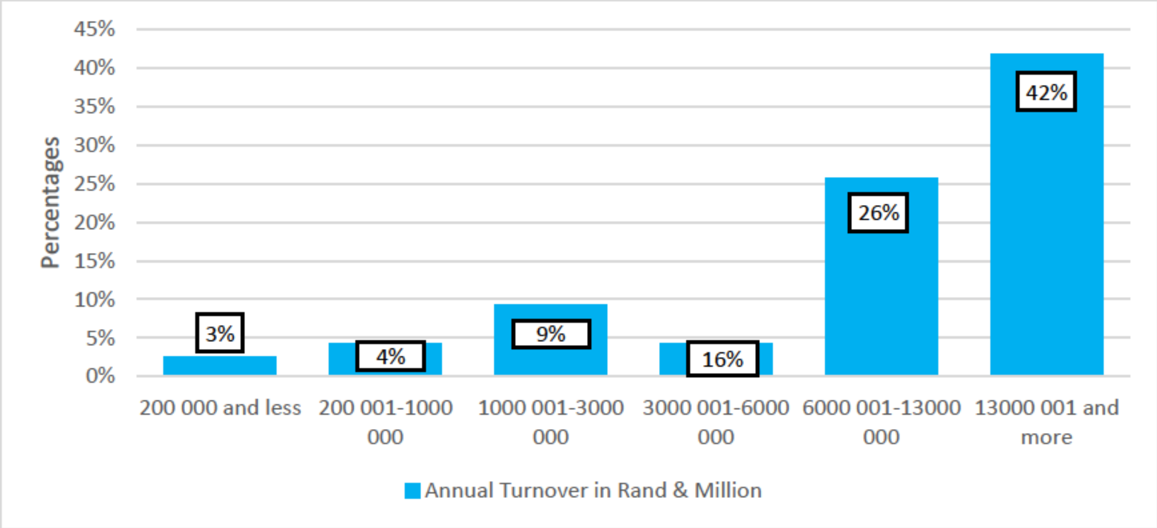


**Figure 4.7: Annual turnover**

## 4.4 DATA ANALYSES ACCORDING TO RESEARCH OBJECTIVES

The design of sections B through D of the questionnaire was modified to effectively meet the study goals. Hence, this section of the chapter presents a comprehensive examination and discourse of the results in alignment with the study's established objectives.

### 4.4.1 Objective 1: To determine smart manufacturing processes used by manufacturing SMEs in Pietermaritzburg

The questionnaire listed 11 items in Section B to determine smart manufacturing processes used by manufacturing SMEs in the research site. The results are analysed below.

#### 4.4.1.1 Utilisation of internet of things technologies

As illustrated in Figure 4.8, the majority of the respondents, at 59%, strongly disagree or disagree that production processes in their respective companies are conducted using IoT technologies. Only 30% either strongly agreed or agreed with the statement, while 11% remained neutral. Therefore, this exposes that the IoT technology is not widely utilised in production processes by manufacturing SMEs. This finding is unfortunate considering that smart manufacturing is intended to maximise useful resource effectiveness and process efficiency in manufacturing through the usage of information and communication technology (Sinsel 2020: 104).

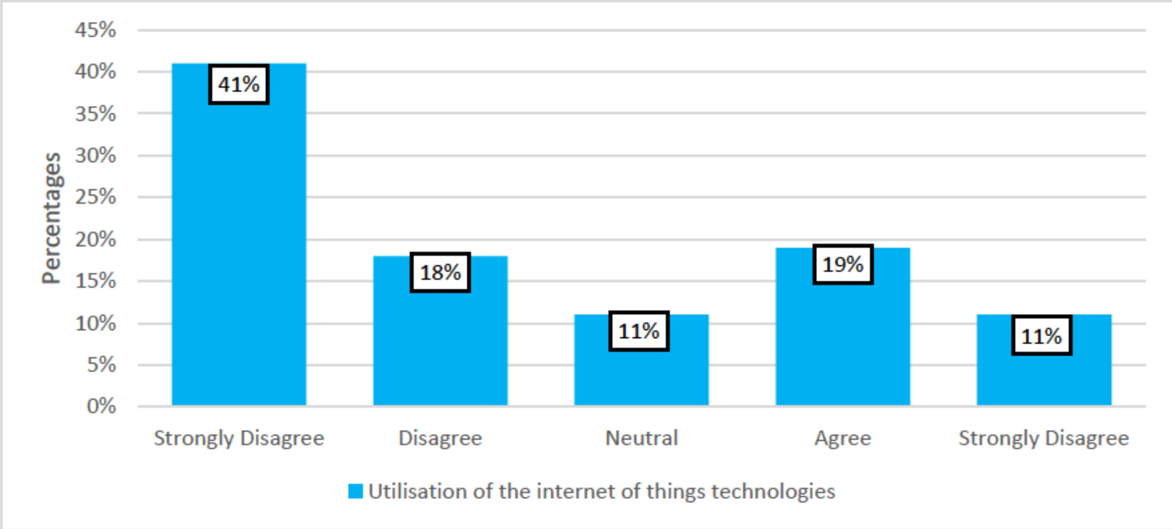


**Figure 4.8: Utilisation of the internet of things technologies**

### 4.4.1.2 Incorporation of artificial intelligence technologies

According to Figure 4.9, 12% and 31% of respondents strongly disagreed and disagreed, respectively. 22% agreed, 9% strongly agreed, and 26% chose to be neutral to the notion that "the production process in their company incorporates artificial intelligence technologies". Figure 4.9, therefore, exposes that many respondents did not utilise artificial intelligence technologies at their company. SMEs' low adoption of artificial intelligence may be due to a lack of awareness, finances, and/or expertise.

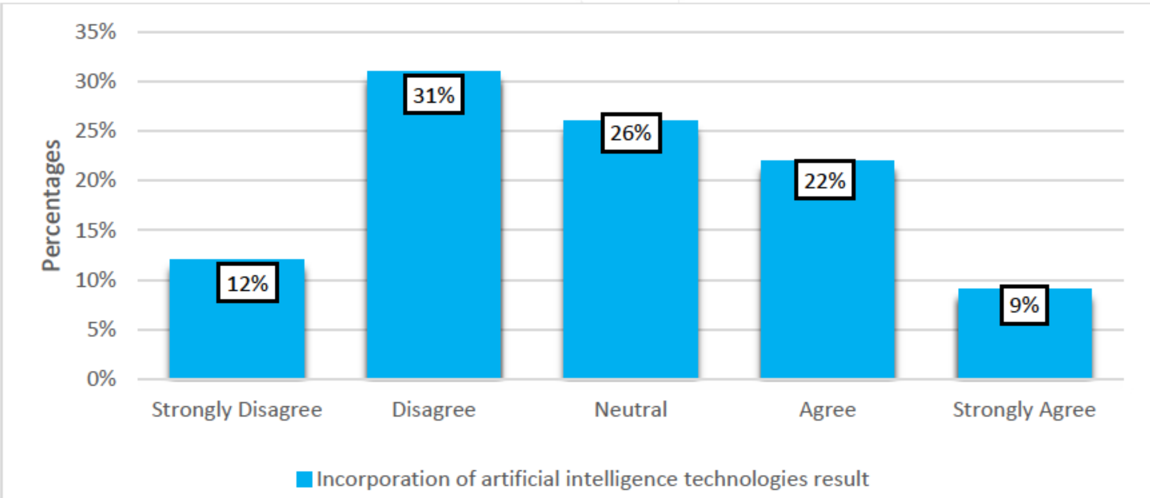


**Figure 4.9: Incorporation of artificial intelligence technologies**

#### 4.4.1.3 Use of robotic technology

As presented in Figure 4.10, 14% and 31% strongly disagreed and disagreed that robotics is used at their companies during production processes, 23% and 11% agreed and strongly agreed, while 21% were neutral. Numerous parts of manufacturing are using robotics to boost productivity and efficiency while minimising costs. Looking at the proportioin of respondents who disagreed or strongly disagreed suggests that most of the respondents did not use robotics technology in the production processes. This is unfortunate considering the fact that robotic technologies are now being adopted in the manufacturing sector to enhance production processes and productivity (Veliu and Manzhari 2017: 65).

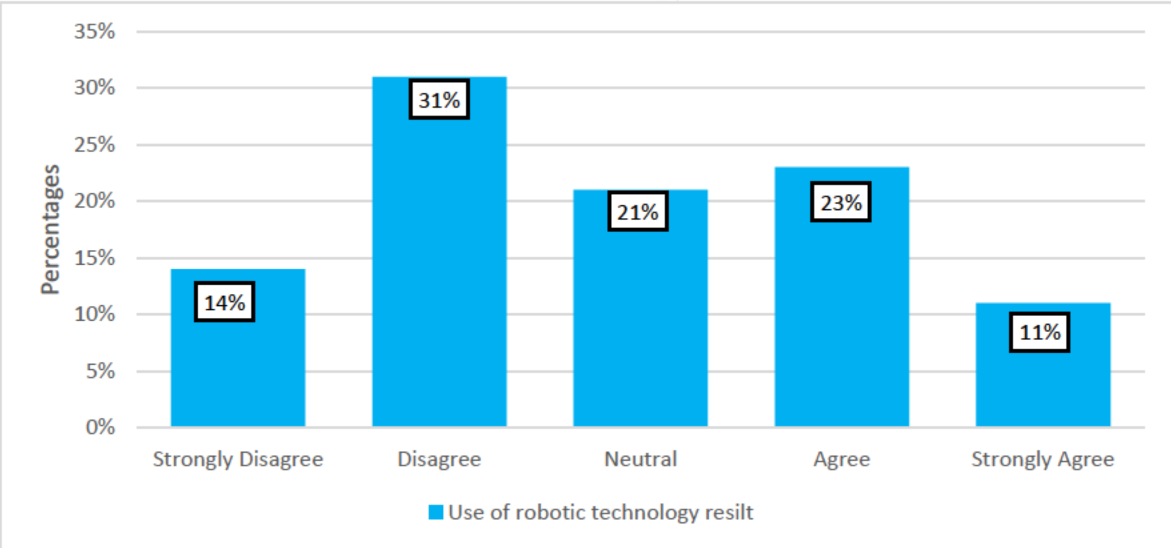


**Figure 4.10: Use of robotic technology**

#### 4.4.1.4 Utilisation of cloud computing

As illustrated in Figure 4.11, the majority of the respondents (10% strongly disagree and 22% disagree) disagree that production processes in their respective companies are conducted using cloud computing. Only 41% either strongly agreed or agreed with the statement, while 27% remained neutral. This outcome suggests that many companies are using cloud computing in their production processes. Cloud computing is commercially viable for many SMEs due to cloudcomputing's inherent flexibility and cost structure that allows for pay-as-you-go arrangements (Shivajee, Singh and Rastogi 2019: 325).

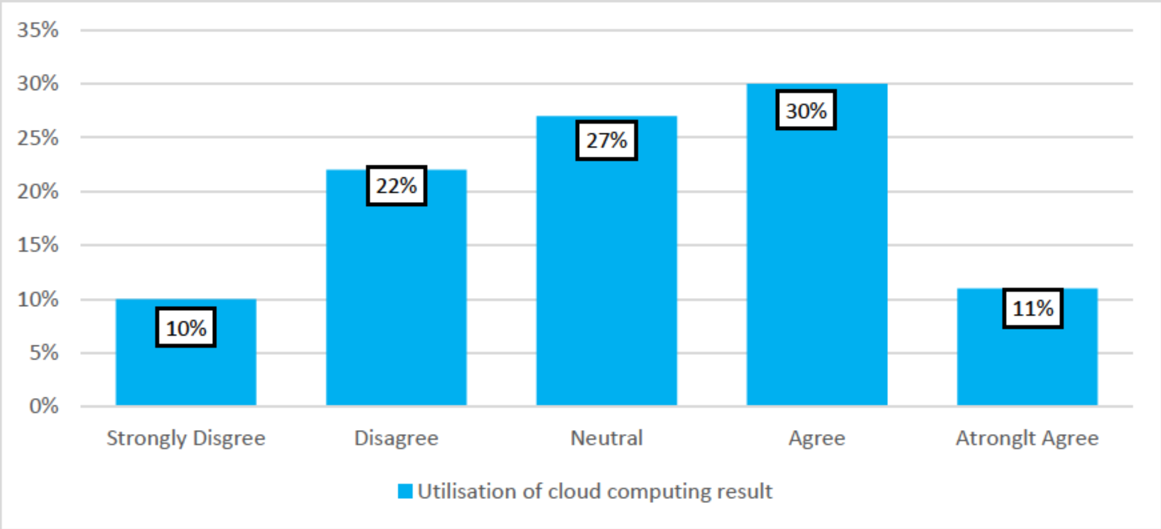


**Figure 4.11: Utilisation of cloud computing**

#### 4.4.1.5 Use of organic-based material

According to Figure 4.12, 8% and 19%, respectively, strongly disagreed and disagreed that the production method uses organic-based material. However, 28% agreed and 14% strongly agreed with the statement, while 31% remained neutral. As the majority agreed with the statement, it reveals that the production method makes use of organic-based material. This is great in the sense that utilising smart manufacturing processes also translates to the adoption of smart materials, including organic-based biomaterials (Sekhametsi 2017: 89). This innovation, according to Ngibe and Lekhanya (2019b: 17-19), encourages the production of future goods. Several new materials will necessitate innovative procedures that must be created and incorporated into smart manufacturing, and this will be a significant contributor to the quest for novel materials (Phuyal, Bista and Bista 2020: 21).

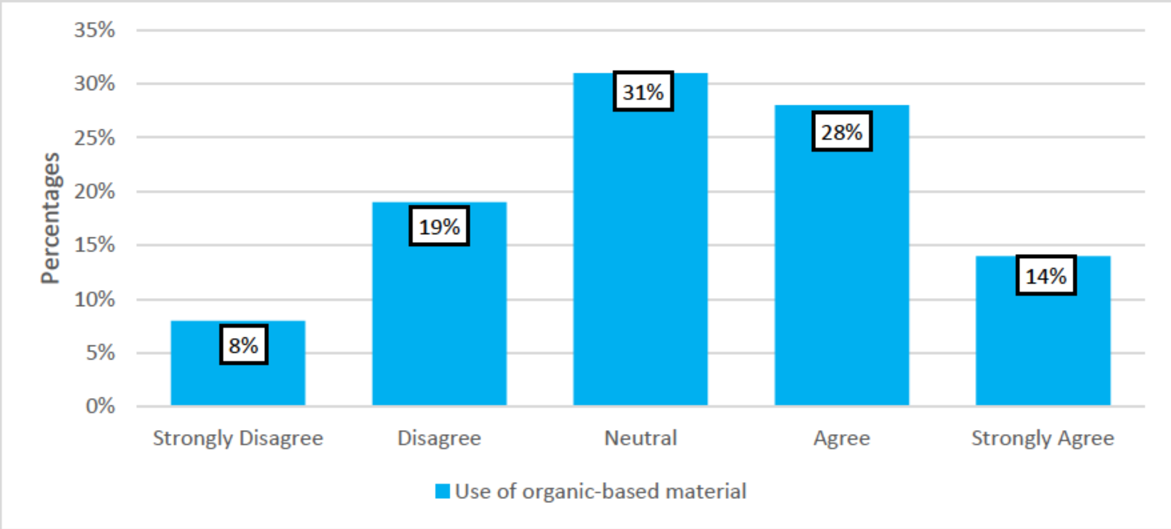


**Figure 4.12: Use of organic-based material**

### 4.4.1.6 Use of bio-material

According to the data shown in Figure 4.13, a significant proportion of the respondents, namely 11% and 25%, expressed disagreement on the utilisation of biomaterials in the manufacturing processes within their respective enterprises. A total of 22% of the participants expressed a neutral stance, while 29% and 13% indicated agreement and strong agreement, respectively, in response to the question. The findings indicate that the organisations under investigation have confirmed their use of biomaterials. Nevertheless, there were several people who expressed their disagreement with the use of biological materials.

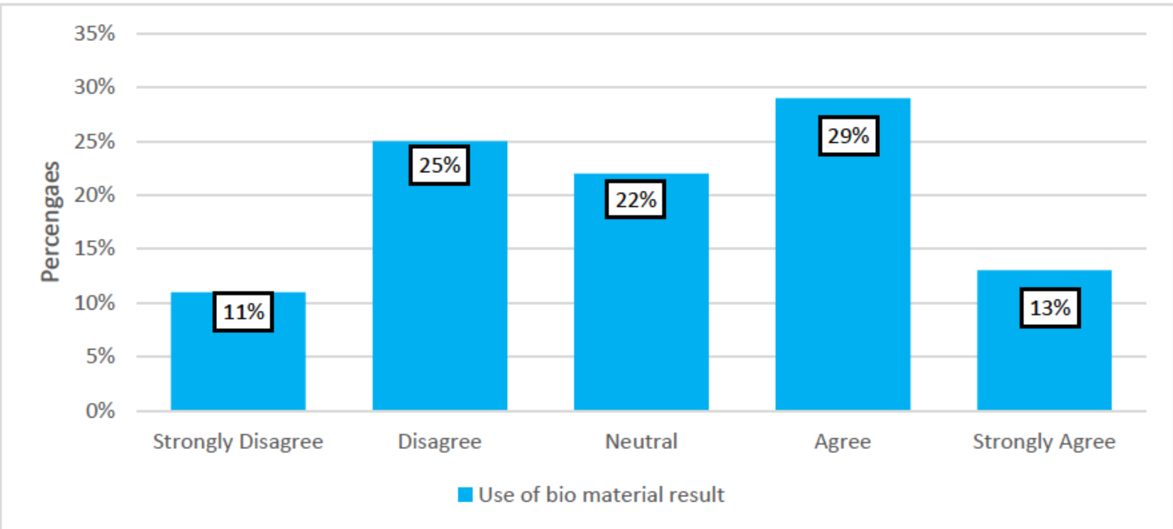


**Figure 4.13: Use of bio-material**

#### 4.4.1.7 Collection of data from diverse sources

Figure 4.14 sjhows whether greater collection of data from diverse sources is applied in SME companies. Based on the findings, 19% of the participants exhibited a neutral stance; however, a significant proportion of them (7% and 25%, respectively) expressed strong disagreement or disagreement with the given remark. On average, 37% and 12% of the participants expressed agreement and strong agreement, respectively, with the concept of a larger collection of data from diverse sources being applied in SME companies. This means that the collection of data by SMEs from a broader range of sources, comprising material characteristics and process parameters, in addition to consumers and suppliers, has commenced (Adamczyk, Szejka, and Canciglieri 2019: 16).

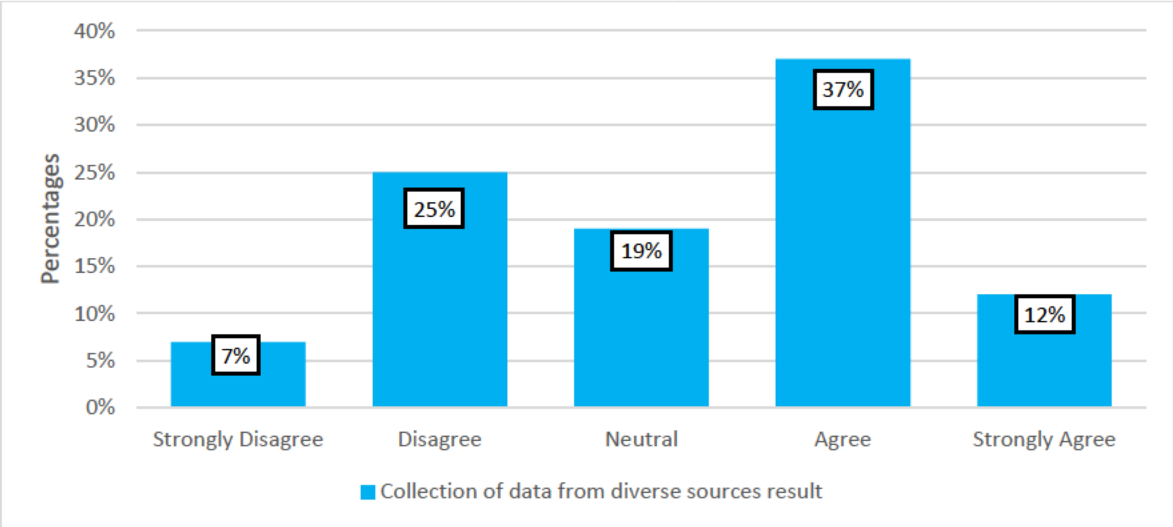


**Figure 4.14 Collection of data from diverse sources**

#### 4.4.1.8 Predictive engineering as a new paradigm

Figure 4.15 shows whether predictive engineering, a new paradigm of constructing high-fidelity models, is used in business. 9% of the respondents strongly disagreed that predictive engineering was used in the business, 22% disagreed, and 30% were neutral. 16% and 23% of the respondents strongly agreed and agreed, respectively, that predictive engineering is a new paradigm for constructing high-fidelity models in business. These findings show that nearly half (39%) of the respondents are utilising predictive engineering as a new paradigm for constructing high-fidelity models in business. Boshoff (2018: 84) argues that predictive engineering provides a whole new approach for creating high-fidelity simulations (digital representations) of the phenomena of interest.

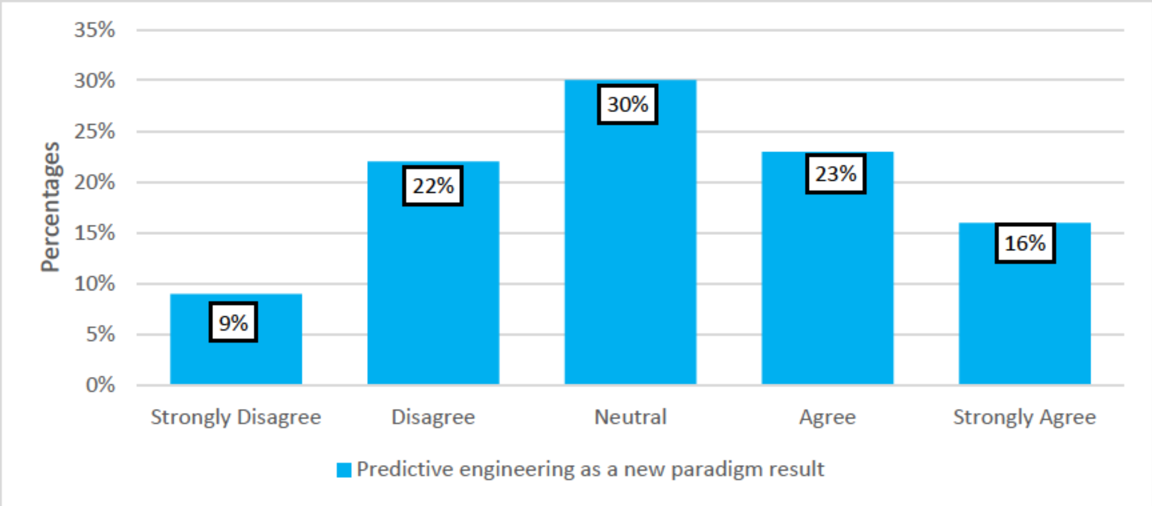


**Figure 4.15: Predictive engineering as a new paradigm**

### 4.4.1.9 Use of smart manufacturing

Figure 4.16 shows that 12.5% of the respondents expressed strong agreement, while 35.4% expressed agreement, regarding the use of smart manufacturing in the production process. Nevertheless, a significant proportion of respondents (19.8%) had a neutral stance towards the remark, while 15.4% opposed it, 25% disagreed, and 7.3% strongly disagreed with it. These results reveal that respondents acknowledge the use of smart manufacturing in production processes. This may be a result of adaptation to the fourth industrial revolution by forgoing traditional manual ways of production and opting for a modern smart production methods.

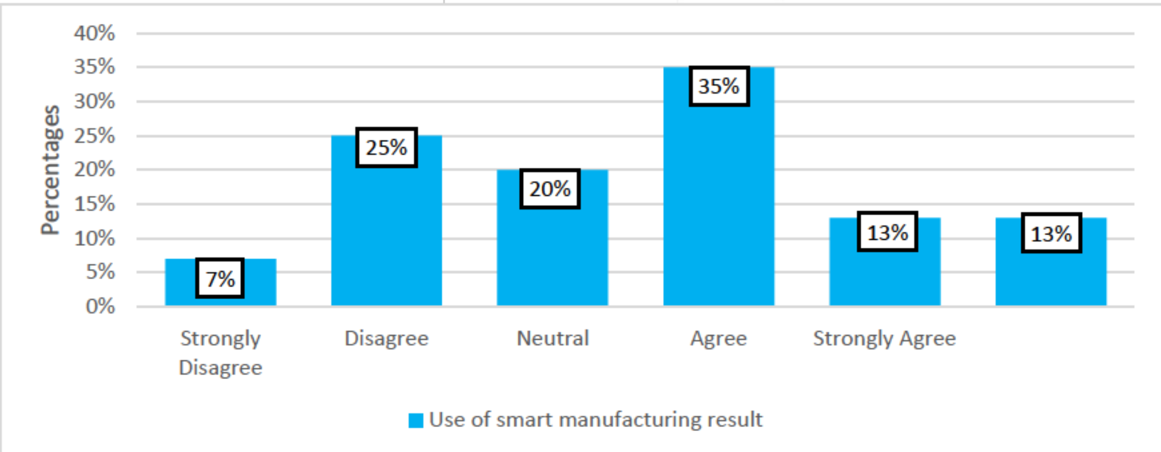


**Figure 4.16: Use of smart manufacturing**

#### 4.4.1.10 Use of smart equipment

According to the data shown in Figure 4.17, a significant proportion of the participants (26%) expressed agreement with the use of intelligent machinery in the context of smart manufacturing operations. Furthermore, a further 22% of respondents expressed strong agreement, while another 22% maintained a neutral stance. A minority of the participants (specifically, 21% and 9%) expressed disagreement or significant disagreement with the use of intelligent machinery in smart manufacturing operations. The results of the study indicate that a significant proportion of the participants (48%) acknowledged their use of intelligent devices in the context of smart manufacturing operations.

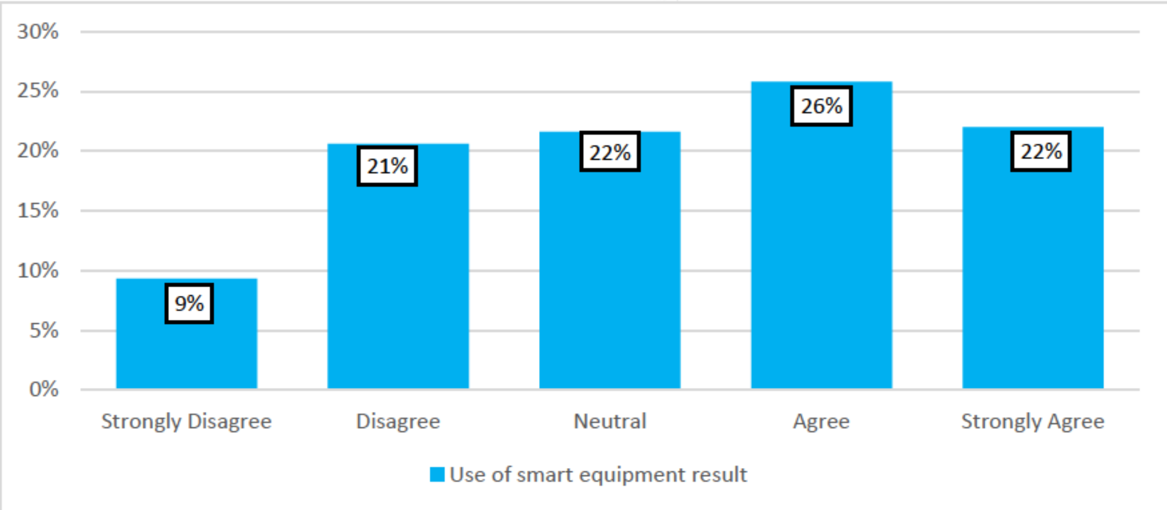


**Figure 4.17: Use of smart equipment**

#### 4.4.1.11 Adoption of enterprise resource production

Figure 4.18 graphically represents whether production processes in companies use enterprise resource production. Based on the findings, 22% and 16% of the respondents strongly disagreed and disagreed, respectively, while 25% remained neutral. On the other hand, 21% agreed and 16% strongly agreed that production in their respective companies uses enterprise resource production processes. It is evident, therefore, that the majority of respondents (44%) do not use enterprise resource production processes in their company. This may be due to a lack of resources that can help them easily adapt to changes in technology.

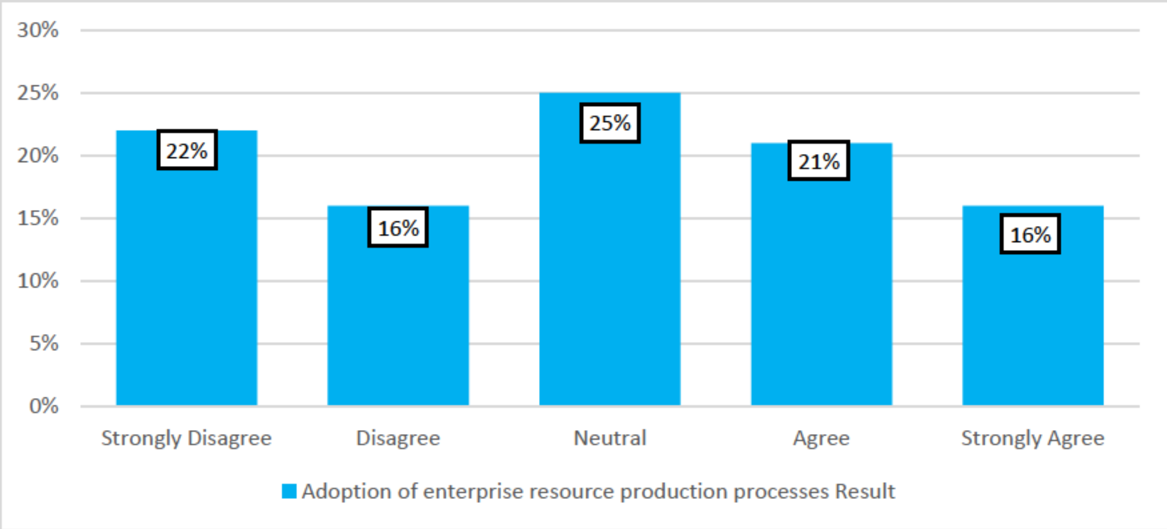


**Figure 4.18: Adoption of enterprise resource production processes**

#### 4.4.1.12 Summary of findings on Objective 1

The adoption of IoTand artificial intelligence technologies in the investigated organisation's is still very low, as shown in Figures 4.8 and 4.9. The findings of this research indicate that the use of robotic technology among manufacturing small and medium enterprises (SMEs) is very limited. The suboptimal adoption rate of smart manufacturing processes may be ascribed to the insufficiency of resources and expertise. It is worth noting that cloud computing is widely adopted by SMEs in manufacturing processes (see Figure 4.11). Moreover, the utilisation of organic-based and bio-based materials is gaining momentum. Likewise, the collection of data from diverse sources is widely applied by manufacturing SMEs. Furthermore, the results show that a significant number of SMEs in the manufacturing sector are utilising predictive engineering as a new paradigm for constructing high-fidelity models in their businesses. Figure 4.17 shows that smart equipment is used by the majority of small manufacturing entities in their operations. However, enterprise resource production is not widely adopted by these entities. The general observation based on the results of objective 1 is that the utilisation of smart manufacturing processes by SMEs in the manufacturing sector is still in its infancy.

### 4.4.2 Objective 2: To analyse innovative leadership practices applied in manufacturing SMEs in Pietermaritzburg

This section highlights the findings of research objective 2, which aimed to analyse innovative leadership practices. The study's participants were asked to respond to 10 statements in section C on the research instrument. The results are shown in Figure 4.19 to Figure 4.28.

#### 4.4.2.1 Emphasis on teamwork

As indicated in Figure 4.19, a total of 45% of the respondents agree or strongly agree that teamwork is emphasised in their companies. On the other hand, a total of 40% of the participants expressed their disagreement with the given statement. The remaining 15% were neutral. From the results, it is evident that teamwork is somewhat stressed. Those who disagree are almost equal to those who agree. Teamwork brings individuals closer to each other (the connecting factor) and encourages them to depend on each other in order to complete tasks (Yıldırım and Demirbağ 2020: 278). Neither of these would be attainable without teamwork.

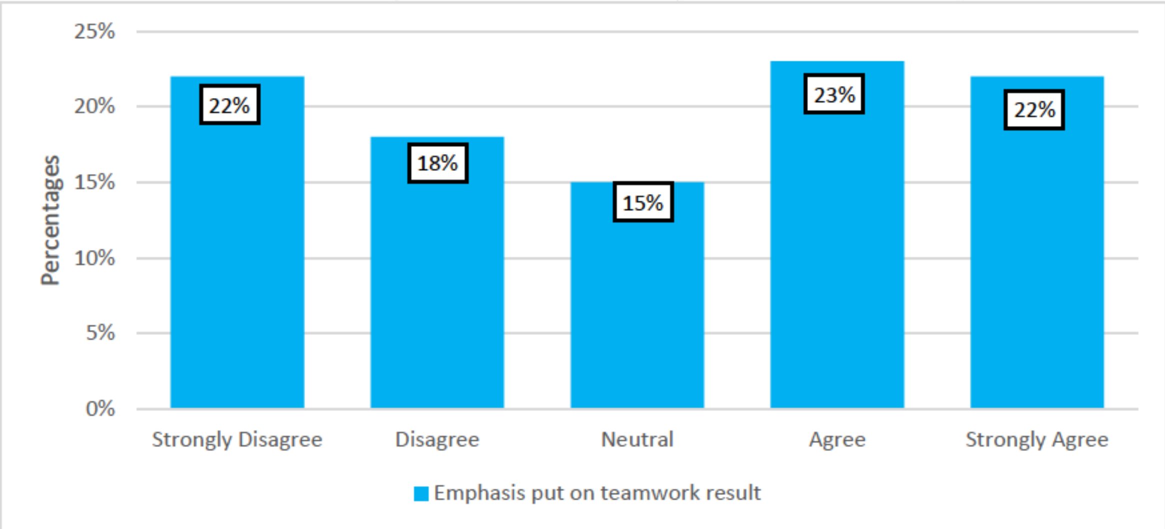


**Figure 4.19: Emphasis on teamwork**

#### 4.4.2.2 Clarification of Individual responsibilities

As seen in Figure 4.20, a collective 49% of respondents express strong agreement or agreement regarding the implementation of innovative leadership inside their particular organisations. A mere 33% of respondents expressed severe disagreement or disagreement, while 18% maintained a neutral stance.

The results indicate that the organisations under investigation engage in the practise of clearly defining individual duties. The definition of roles has significance as it serves to provide guidance and coordination to workers about their job activities, ensuring their understanding of their anticipated responsibilities (Gil-Garcia *et al 2019: 258)*

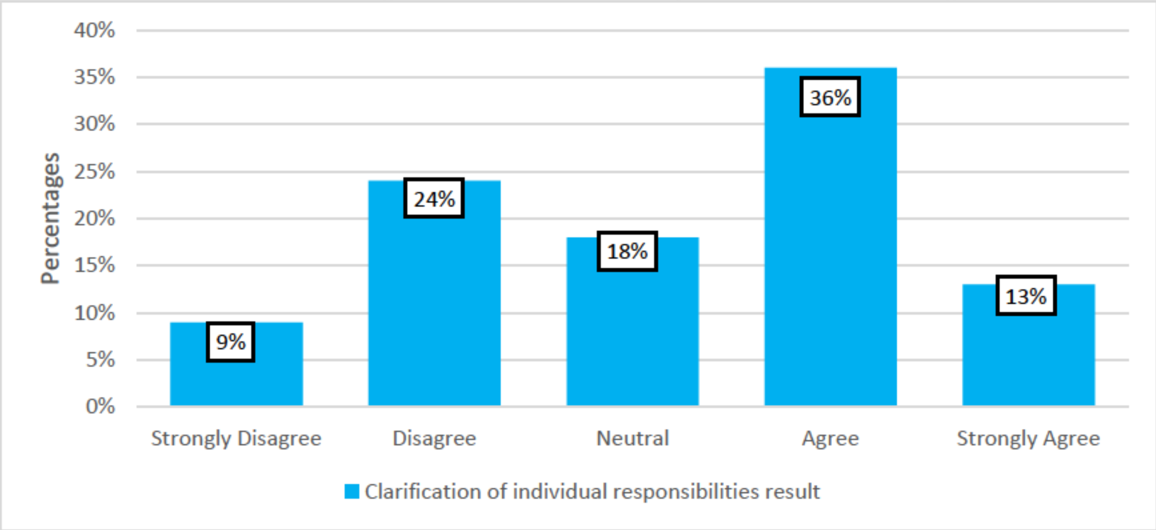


**Figure 4.20: Clarification of individual responsibilities**

### 4.4.2.3 Provision of clear feedback

Figure 4.21 indicates whether clear feedback is always provided to the employees. The majority of participants (31% and 23%) strongly agreed or agreed to innovative leadership practised in their respective companies in the context of the provision of clear feedback. A total of 27% strongly disagree or disagree that clear feedback is always provided to the employees, while 19% were neutral. Based on the findings, it can be concluded that in the investigated organisations, leadership does give clear feedback to their employees. Organisations must give clear feedback to employees so that they are aware of how they have performed and can be motivated, and can correct their mistakes (Bozdoanolu 2019: 19).

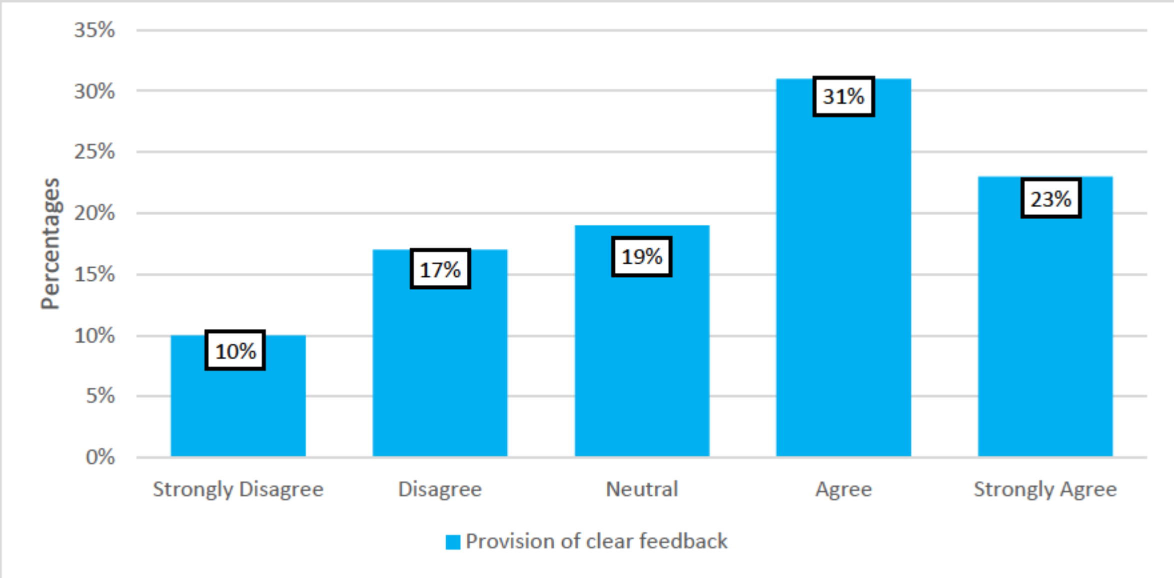


**Figure 4.21: Provision of clear feedback**

### 4.4.2.4 Task orientation

The data shown in Figure 4.22 demonstrates that a significant majority of respondents, accounting for 52%, expressed agreement or strong agreement with the statement about the focus on task orientation within their particular organisations' leadership. A total of 26% of the participants expressed disagreement or strong disagreement, while 21% indicated a neutral stance. With 53% of respondents strongly agreeing or agreeing, these findings show that leadership in their companies does emphasise task orientation. This confirms the presence of this attribute of innovative leadership.

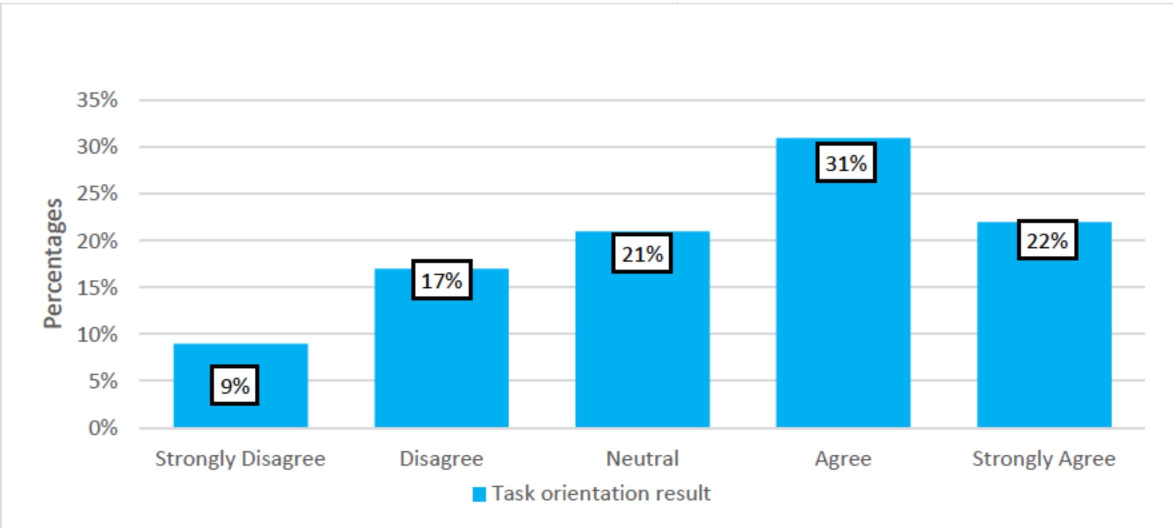


**Figure 4.22: Task orientation**

#### 4.4.2.5 Encouraging initiative

According to the results in Figure 4.23, the majority of respondents (59%) agree that leadership in their respective companies encourages initiative. On the other hand, 17% of the participants disagreed, while 23% remained neutral. The result indicates that innovative leadership practices in their respective companies are encouraged. Encouraging initiative promotes flexibility and a conducive working environment. By supporting initiative, innovation and invention may be enhanced (Lekhanya, 2015: 221; Dlamini, 2017: 3).

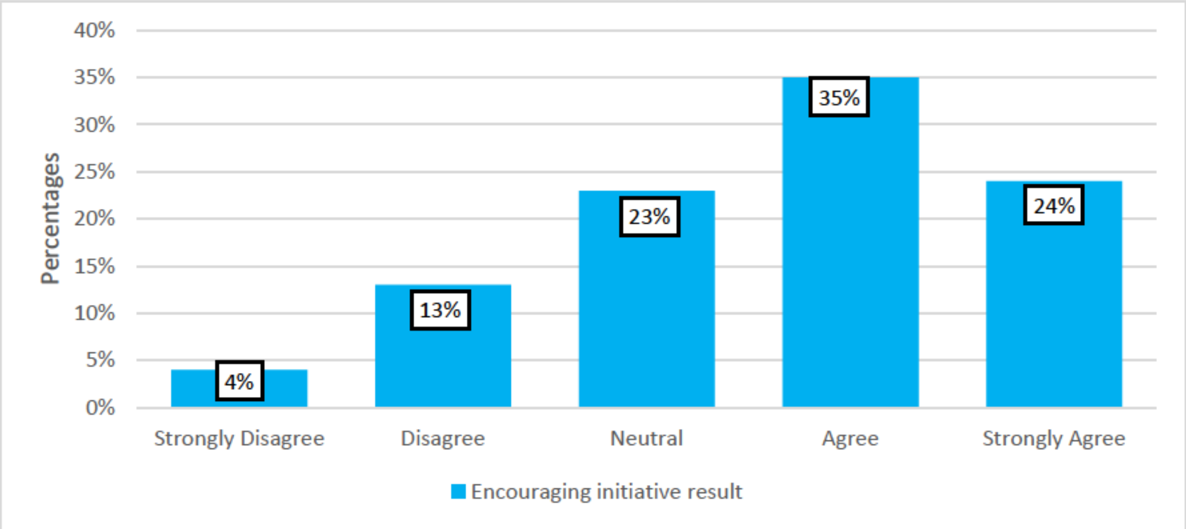


**Figure 4.23: Encouraging initiative**

#### 4.4.2.6 Encouraging innovative problem-solving

As seen in Figure 4.24, a significant majority of respondents, comprising 57%, express strong agreement or agreement about the implementation of creative problem-solving inside their particular organisations. A mere 23% of respondents expressed severe disagreement or disagreement, while a little over 20% maintained a neutral stance. The data indicate that there is widespread encouragement of problem-solving creativity. The findings of this study indicate that SMEs possess a comprehension and recognition of creative problem-solving methods, as shown by their active encouragement of workers to use such strategies.

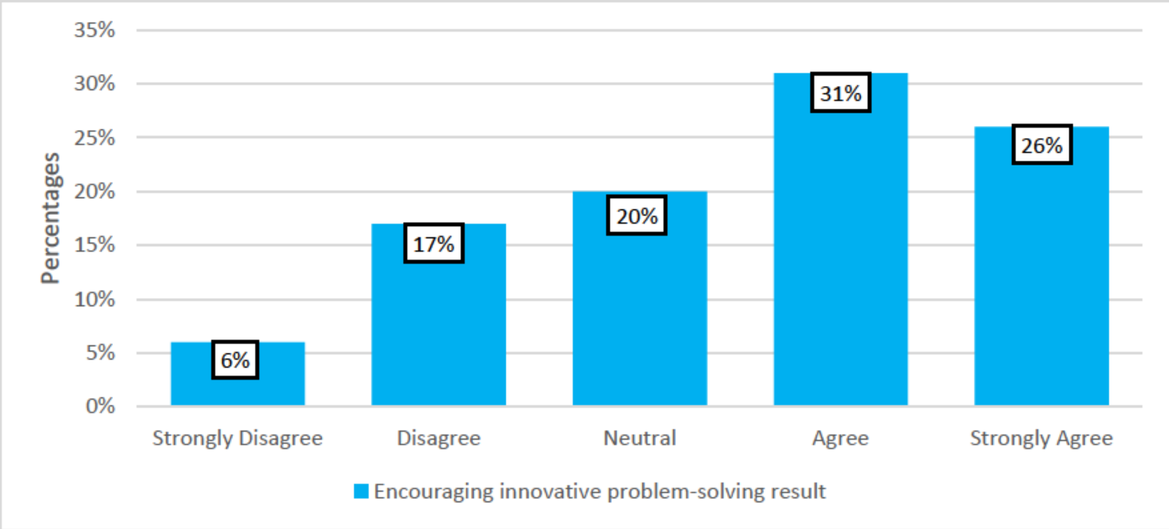


**Figure 4.24: Encouraging innovative problem-solving**

#### 4.4.2.7 Training on the process of creative idea generation

Figure 4.25 illustrates that 33% and 17% of the respondents strongly agree or agree that their respective organisations train employees on the process of creative idea generation. On the other hand, 20% of the respondents were neutral about this stance in the context of their organisations. A total of 30% disagree or strongly disagree with the statement. The results show that the majority of SMEs engage in training activities to enhance employee's creative idea-generation skills.

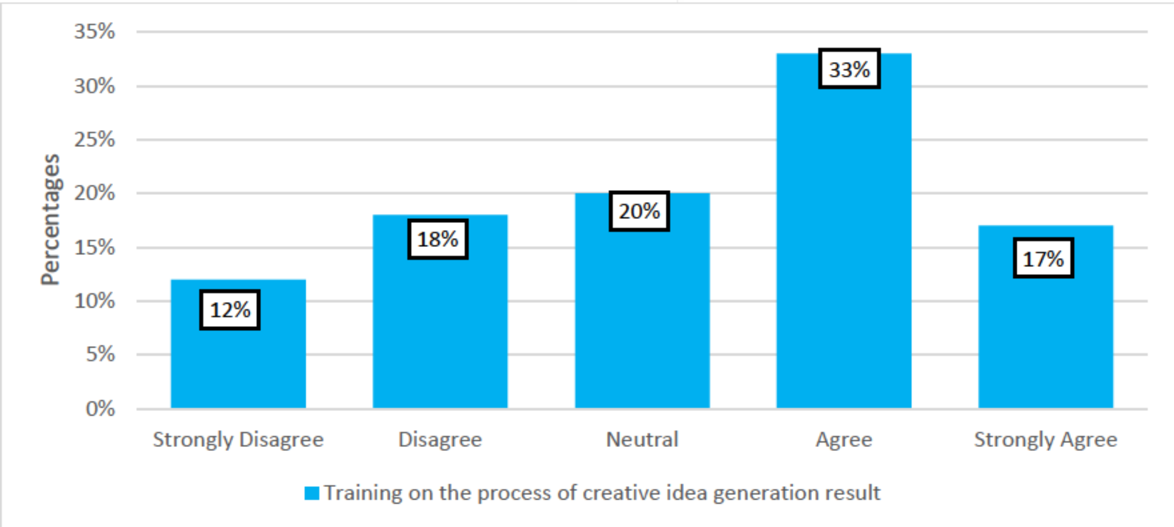


**Figure 4.25: Training on the process of creative idea generation**

#### 4.4.2.8 Active documentation of new knowledge and skills

According to the data shown in Figure 4.26, it is evident that a significant proportion, namely 22%, of the participants expressed strong disagreement or disagreement on the presence of active documentation of novel knowledge and abilities inside their respective organisations. Conversely, a majority of 51% expressed strong agreement, while 27% maintained a neutral stance. Innovative leadership is characterised by the implementation of active recording of new information and skills inside their own organisations. The acquisition of new information and skills may be very advantageous for SMEs since it enhances productivity and facilitates the preservation of knowledge inside these organisations.

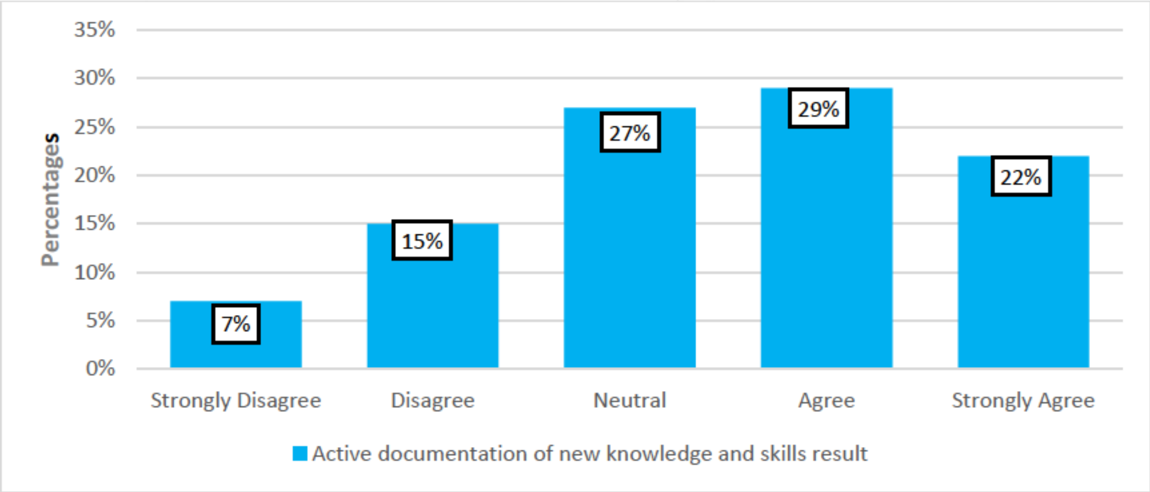


**Figure 4.26: Active documentation of new knowledge and skills**

#### 4.4.2.9 Formal problem-solving process supporting innovation

According to the data shown in Figure 4.27, a notable proportion of participants (51%) express consensus about the implementation of a formal problem-solving procedure that facilitates innovation inside their respective organisations. Only a few respondents (22%) disagreed that organisations are supplying formal problem-solving processes that support innovation, and 27% were neutral. This finding leads to the conclusion that organisations are enhancing innovation by promoting formal problem-solving processes.

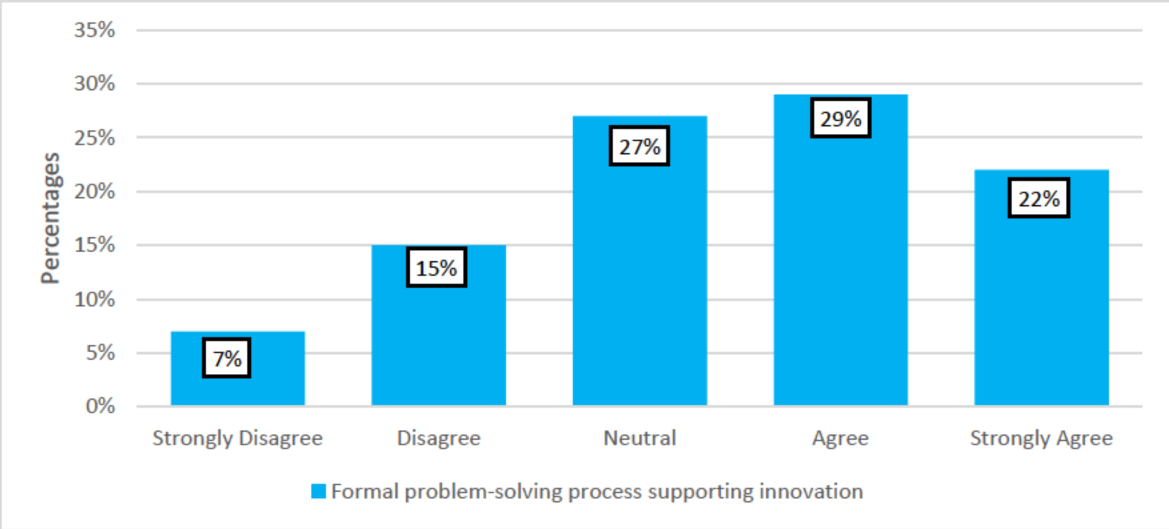


**Figure 4.27: Formal problem-solving process supporting innovation**

#### 4.4.2.10 Training of staff to develop innovative problem-solving skills

Figure 4.28 indicates that the majority of the respondents (64%) strongly agreed that organisations offer training to staff in order to develop innovative problem-solving skills. Findings further revealed that 19% of the respondents were not sure of this notion. The graphic presentation also depicts that only 17% strongly disagreed or disagreed. Based on these results, leadership in the investigated companies does provide training to employees in order to develop innovative problem-solving skills. Employees with strong problem-solving abilities can deal with the difficult challenges and conditions encountered in the course of smart manufacturing.

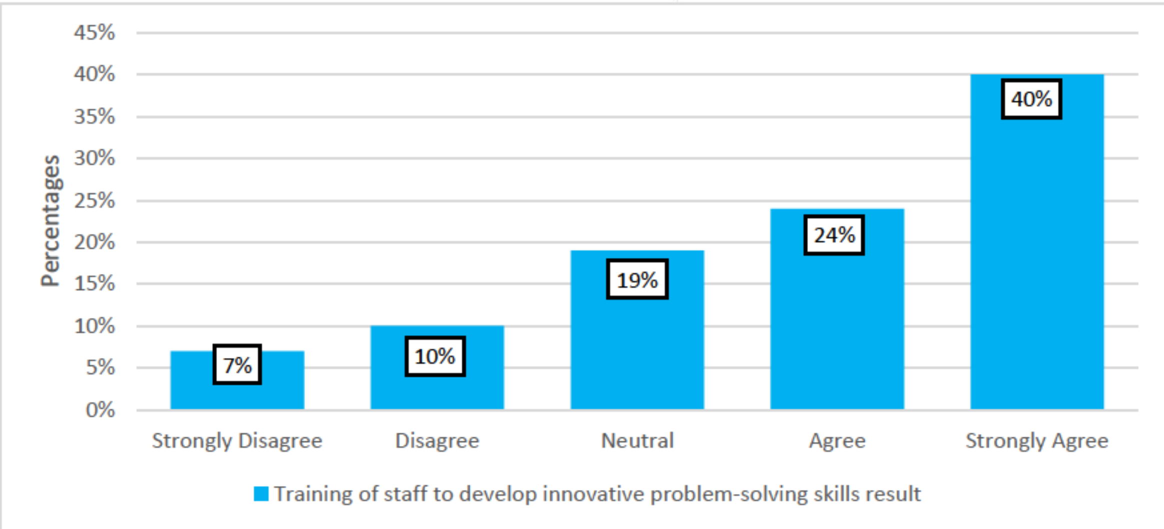


**Figure 4.28: Training of staff to develop innovative problem-solving skills**

#### 4.4.2.11 Summary of findings on Objective 2

The analysed firms exhibit a notable presence of innovative leadership. The findings indicate that the level of focus placed on cooperation and the explanation of individual duties within the firms under investigation is of modest magnitude. The findings of this research demonstrate a significant correlation between giving explicit feedback and the presence of innovative leadership. The use of task orientation, encouragement of initiative, and promotion of creative problem-solving are prominently seen in the innovative leadership processes shown in Figures 4.22 to 4.24. Moreover, the findings indicate that a considerable proportion of innovative leadership practices are extensively used inside the examined SMEs. These practices include providing training on the procedures involved in generating creative ideas as well as actively documenting novel knowledge and abilities. In addition, the training of workers to cultivate inventive problem-solving talents is mostly used. Based on the results of goal 2, it can be concluded that there is substantial evidence supporting the presence of innovative leadership practices inside SMEs operating in the manufacturing sector. This provides an opportunity for these companies to advance the smart manufacturing agenda through effective leadership.

### 4.4.3 Objective 3: To identify factors that affect the adoption of smart manufacturing processes by SMEs in Pietermaritzburg

This section examines the many elements that influence the implementation of smart manufacturing processes among small and medium-sized enterprises (SMEs). Section D of the questionnaire had a total of 11 questions. The results are shown in Figures 4.29 to 4.39.

#### 4.4.3.1 The adoption of innovative production processes

The results shown in Figure 4.29 indicate that 26% of the participants agreed, while 12% strongly agreed, with the adoption of new manufacturing techniques. Additionally, 28% of the respondents expressed a neutral stance on this matter. In contrast, a notable proportion of the participants, namely 16% and 18%, expressed significant disagreement and disagreement regarding the given proposition. The outcomes of this study provide strong evidence that the adoption of innovative manufacturing processes in the businesses under investigation remains significantly limited.

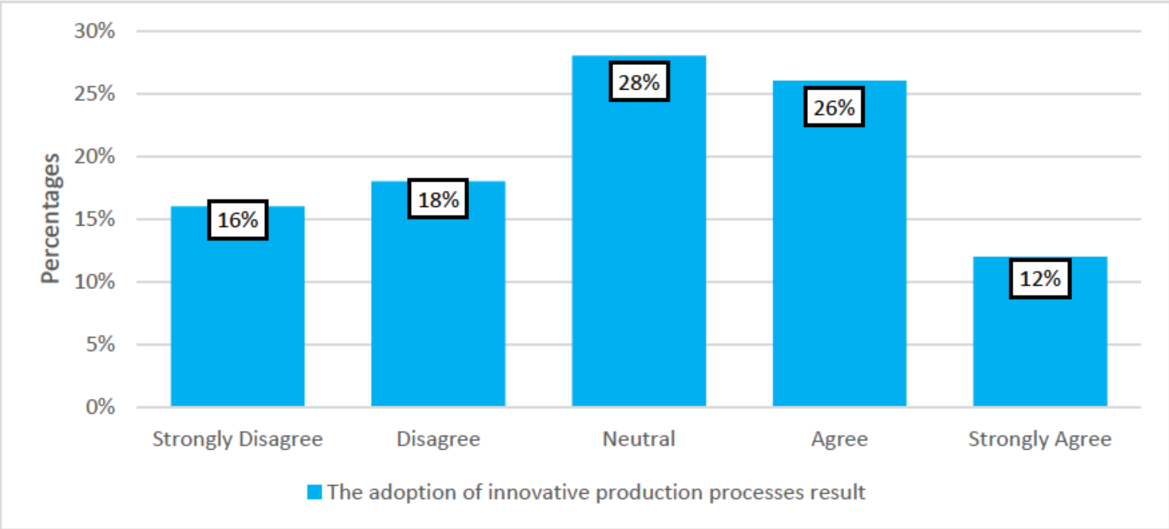


**Figure 4.29: The adoption of innovative production processes**

### 4.4.3.2 Competitive concentration

According to the data shown in Figure 4.30, 42% of the participants surveyed expressed agreement with the notion that competitive concentration within the sector has an impact on smart manufacturing processes. Conversely, a significant proportion (30%) of the participants expressed disagreement over the aforementioned assertion. The remaining 28% had a neutral stance. The findings suggest that competitive concentration has a discernible impact on smart manufacturing processes.

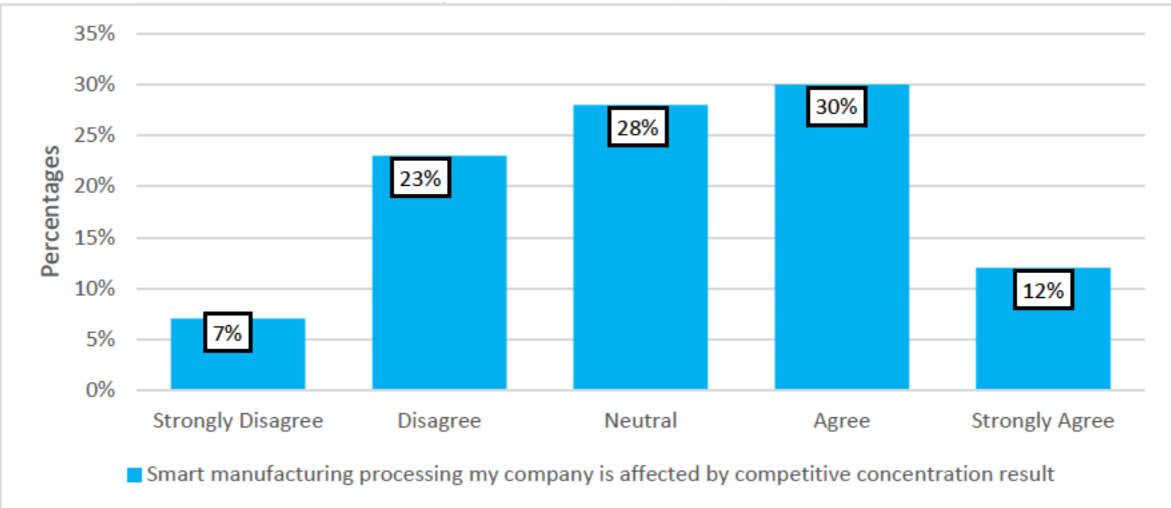


**Figure 4.30: Competitive concentration**

#### 4.4.3.3 Laws and regulations

Figure 4.31 reveals that 44% of respondents strongly agreed or agreed that a number of laws and regulations had an impact on the adoption of smart manufacturing processes. Thirty three per cent were neutral, while 23% strongly disagreed or disagreed. These findings suggest that a number of laws, rules, and regulations have an impact on the adoption of smart manufacturing processes. The fact that a huge percentage (apart from those who responded neutrally) agreed shows that environmental laws, intellectual property laws, and labour laws are affecting the adoption of smart manufacturing in their SMEs. Tomy and Pardede (2018: 9)support these findings and add that any country's government is responsible for establishing rules, legal structures, and processes that control how business is done inside its boundaries. These regulations control the compliance requirements for smart manufacturing SMEs, with major ramifications for the organisation's operations. If not followed, these entities face severe consequences.

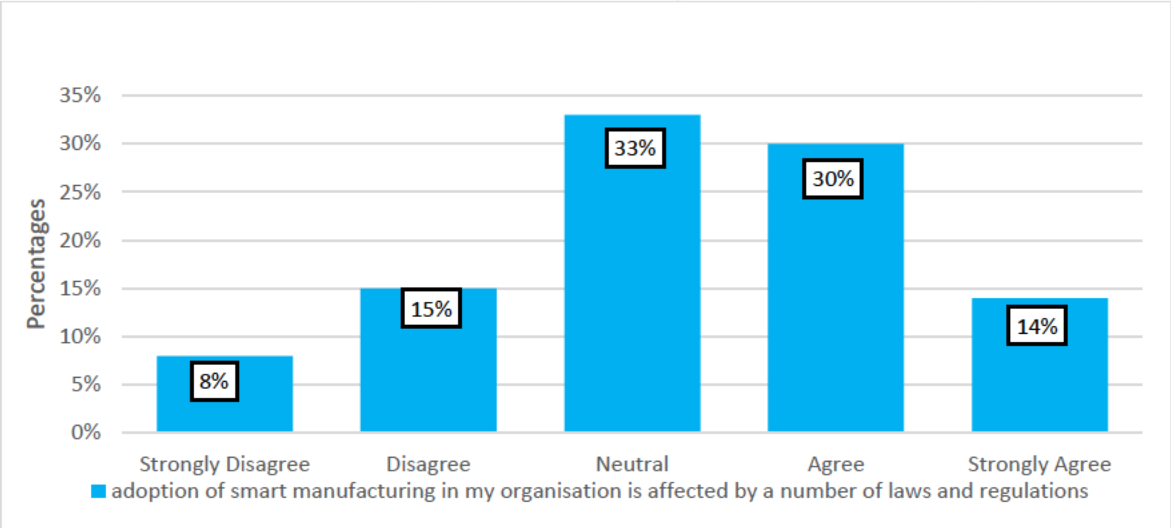


**Figure 4.31: Laws and regulations**

#### 4.4.3.4 Lack of adoption of information technology

Based on the findings, as reflected in 4.32, a considerable number of respondents (54%) disagreed or strongly disagreed that adoption of information technology limits their organisation from fully adopting smart manufacturing processes, while fewer respondents (28%) agreed or strongly agreed. Eighteen per cent of respondents expressed neutrality towards the remark. This data unequivocally demonstrates that the respondents do not see the lack of adoption of information technology as an impediment to the adoption of smart manufacturing processes. Considering the low adoption rate of smart manufacturing processes, while lack of information technology is not considered a hindrance, the implication here is that technological innovation adopted by these entities is not utilised to its full potential.

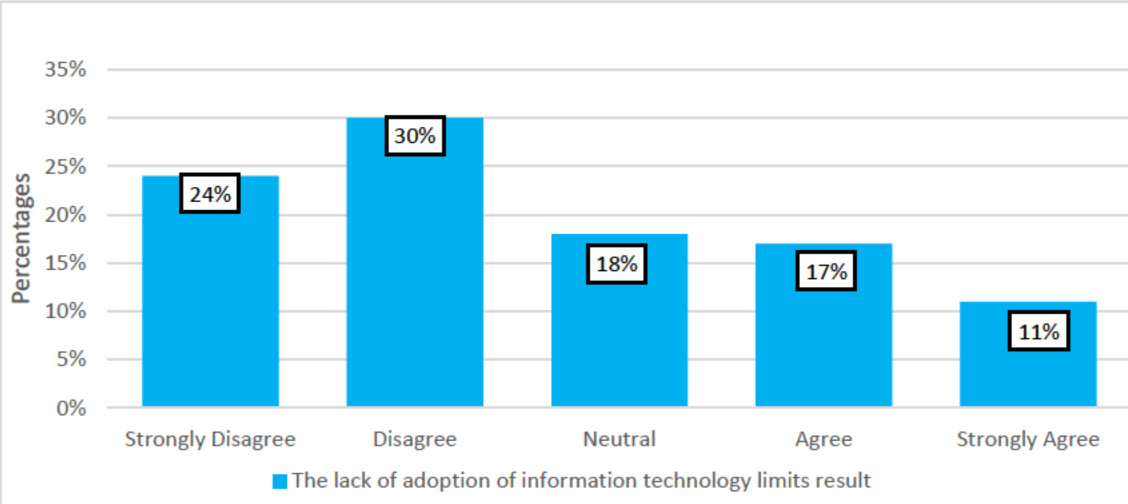


**Figure 4.32: Lack of adoption of information technology**

### 4.4.3.5 New technology implementation costs

Figure 4.33 reflects that 43% of respondents agreed or strongly agreed that smart manufacturing in their organisation is affected by new technology implementation costs. While 23% were neutral, a total of 34% strongly disagreed and disagreed with the statement above, respectively. The number of agreeing participants is higher than that of those who disagree that smart manufacturing in their organisation is affected by new technology implementation costs. This may also explain the findings of Figure 4.32, which indicated that the presence of technology is not necessarily a hindrance to smart manufacturing. Instead, it is the cost of exploring more features of the available technologies that is hindering a much wider adoption of smart manufacturing processes. Large-scale manufacturers are forgoing smart manufacturing since they perceive it as being too costly and to be a possible cause of future losses (Schein and Schein 2017: 26).

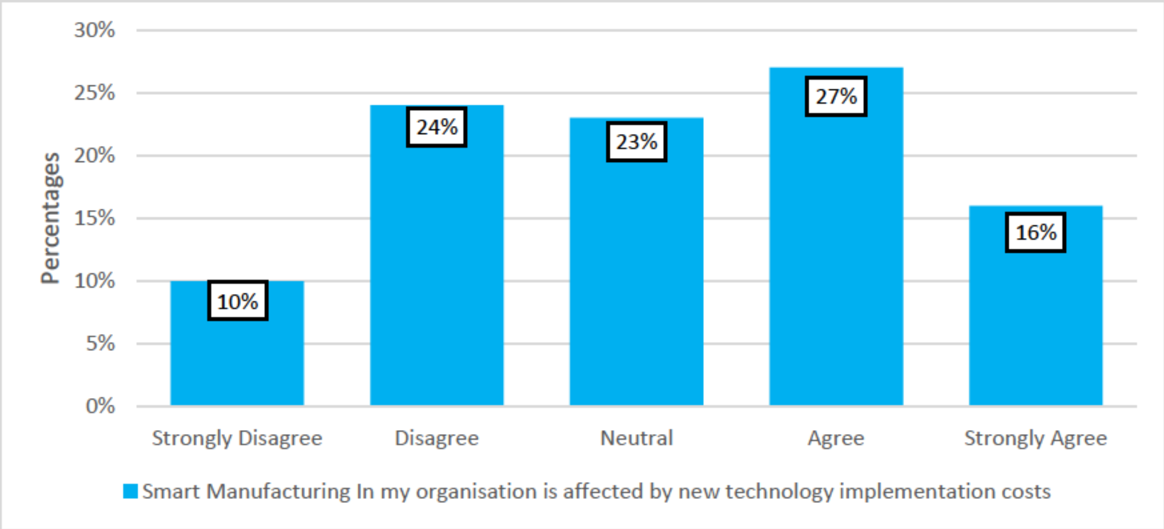


**Figure 4.33: New technology implementation costs**

### 4.4.3.6 Limited/shortage of space

Based on the findings shown in Figure 4.34, it is evident that 44% of the participants agreed that their innovation was influenced by a restricted or inadequate spatial environment. The findings indicate that a significant proportion of respondents, namely 32%, had a neutral stance towards the remark, while 24% exhibited disagreement. The literature has proven that a certain amount of space is required to facilitate the occurrence of innovation (Bushe 2019: 29). The findings indicate that a lack of available space is a significant obstacle to the development and implementation of innovative practices.

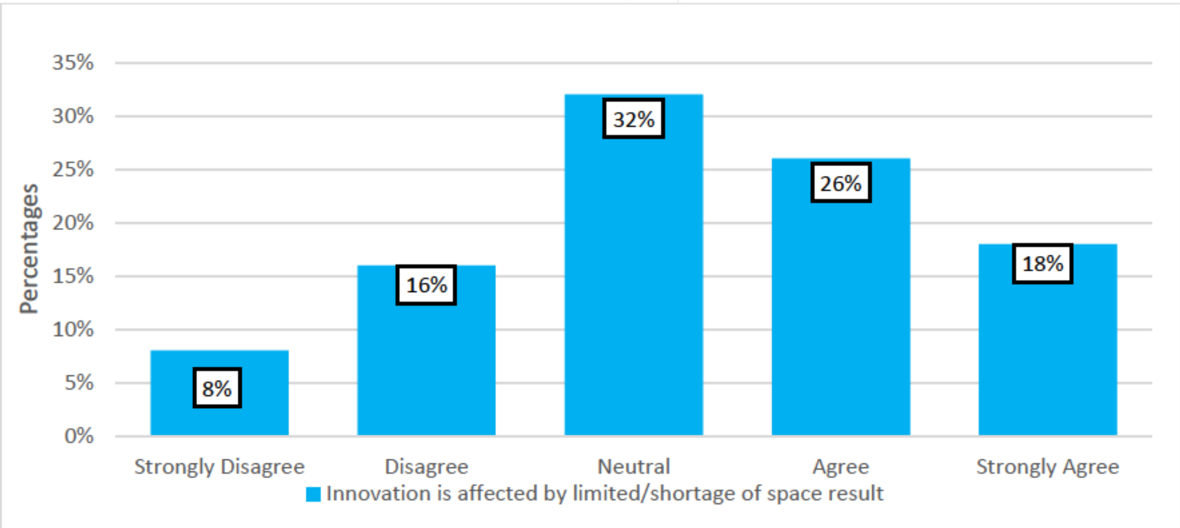


**Figure 4.34: Limited/shortage of space**

#### 4.4.3.7 Lack of funding

According to an analysis of Figure 4.35, 54% of the respondents agreed or strongly agreed that lack of funding affects the adoption of smart manufacturing processes in their organisation, 17% were neutral about the statement, and 29% disagreed or strongly disagreed. The majority of respondents acknowledged that a lack of funding has a huge impact on the adoption of smart manufacturing processes. This finding is supported by the work of Woldie, Laurence and Thomas (2018: 49), who concluded that a lack of funding has been recognised as a barrier to smart manufacturing. Quartey *et al.* (2017: 19) also add that smart manufacturing faces a generally recognised problem of lack of access to funding as the new technology machines are costly. Therefore, SMEs face a generally recognised concern that has been identified as a shortage of finances or an inability to obtain funds or credit.

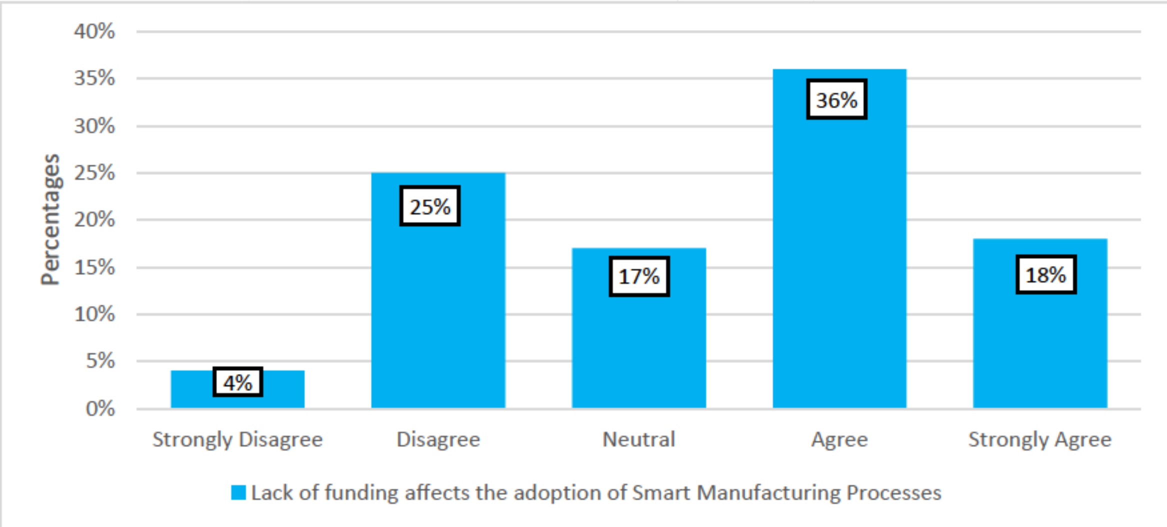


**Figure 4.35: Lack of funding**

#### 4.4.3.8 Lack of new technology

Figure 4.36 shows that 30% of the respondents were neutral about the notion that a lack of adoption of new technology is affecting innovation in their respective companies. The study also found that 22% were in disagreement while 48% were in agreement. From the findings, we can conclude that not having adequate new technology adoption has an effect on the adoption of smart manufacturing processes. This explains why there has been such a slow uptake of intelligent manufacturing processes. Access to capital is one of the factors that prevents small and medium-sized businesses from purchasing and implementing innovative technology, as was previously stated.

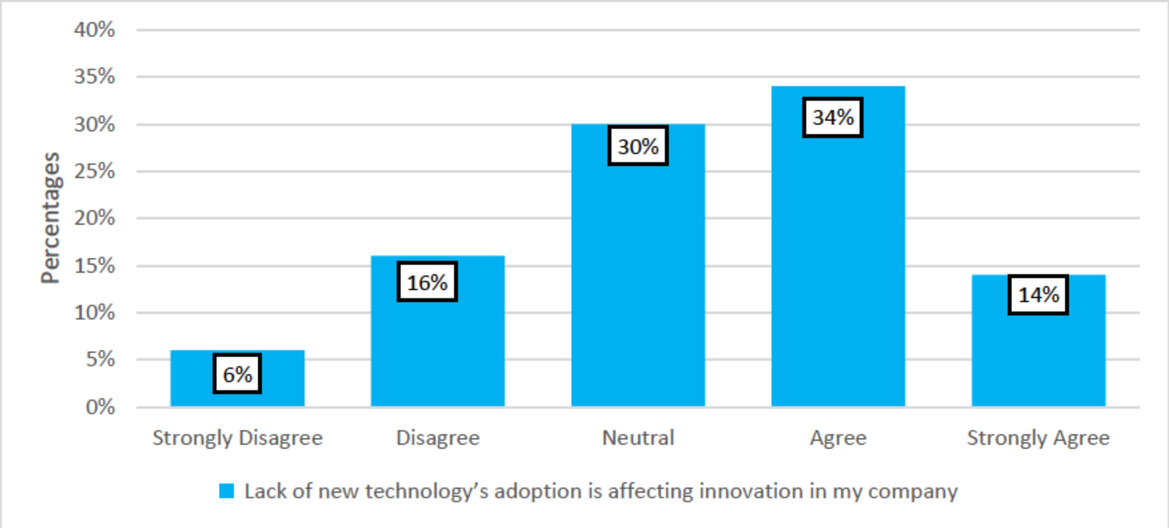


**Figure 4.36: Lack of new technology**

#### 4.4.3.9 The application of ISO standards

Figure 4.37 illustrates that a total of 24% were neutral about the application of ISO standards in their company in order to perform smart production processes. Furthermore, the result showed that 34% of the respondents disagreed or strongly disagreed, while 42% strongly agreed or agreed. The findings show that complying with ISO standards is not regarded as a high priority for manufacturing SMEs. Eniola and Entebang (2016: 40) corroborate this finding by stating that ISO standards are not viewed as compulsory in most SMEs. The majority of companies are implementing ISO standards for their safety benefits and also for the sake of external public relations or image (Reis 2018: 89).

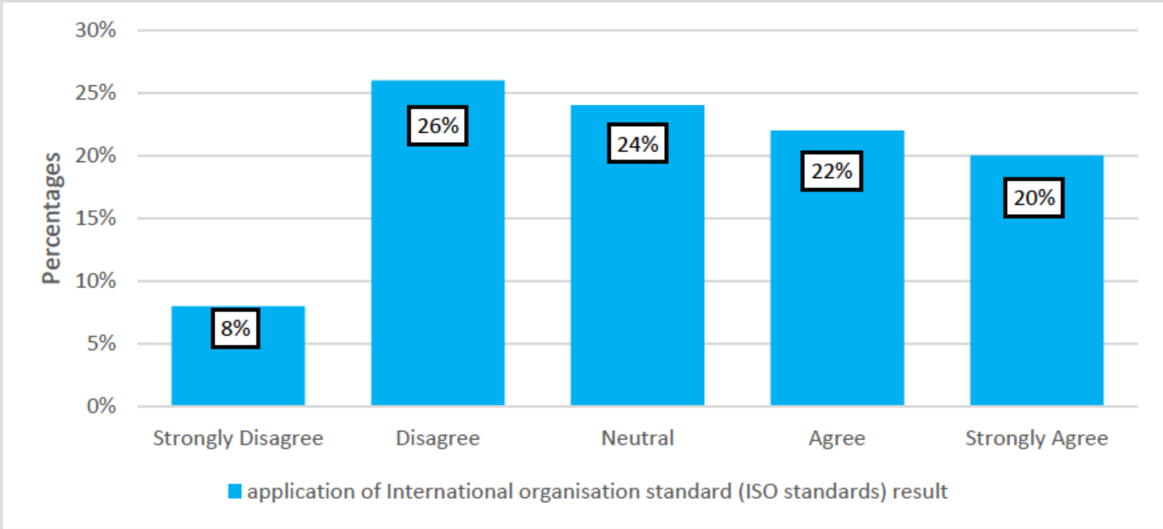


**Figure 4.37: The application of ISO standards**

### 4.4.3.10 Lack of Innovative education and training

According to Figure 4.38, around 26% of the participants had a neutral stance towards the statement regarding the potential impact of a deficiency in innovative education and training on smart manufacturing. In contrast, a significant proportion of respondents, namely 9% and 11%, expressed strong disagreement and disagreement, respectively with this statement, while 36% and 18%, respectively, agreed and strongly agreed. According to research findings on this question, smart manufacturing is affected by a lack of innovative education and training. These findings are supported by Pinto, Goncaives, and Reis (2018: 33), who state that most SMEs do not participate in smart manufacturing owing to low participation in workers' creative education and training.

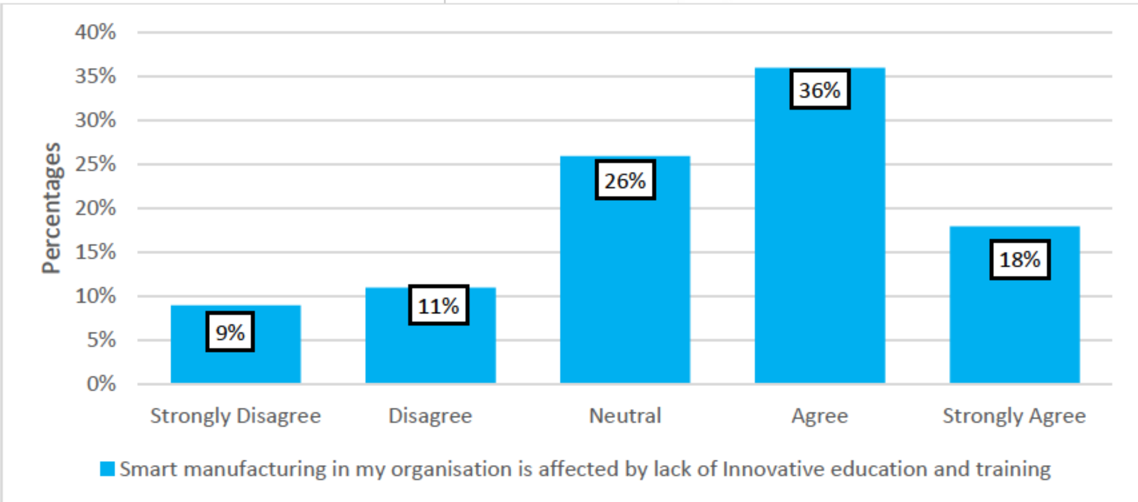


**Figure 4.38: Lack of Innovative education and training**

#### 4.4.3.11 Operating licence

Figure 4.39 reveals that the majority of respondents (57%) strongly agreed that an operational licencing is required for their manufacturing processes. Meanwhile, 25% strongly disagreed or disagreed with the statement, and 18% were neutral. The result shows that more than half of participants agree that operational licencing is required for their manufacturing processes. Boshoff (2018: 89) highlights that a manufacturer's licence is compulsory for both total and partial manufacturing processes and even for minor processes such as packaging, value addition, and modification. Therefore, these findings clearly show that a licence is needed for a business to be involved in manufacturing processes. However, this does not guarantee participation in smart manufacturing, This some do not following licencing requirements

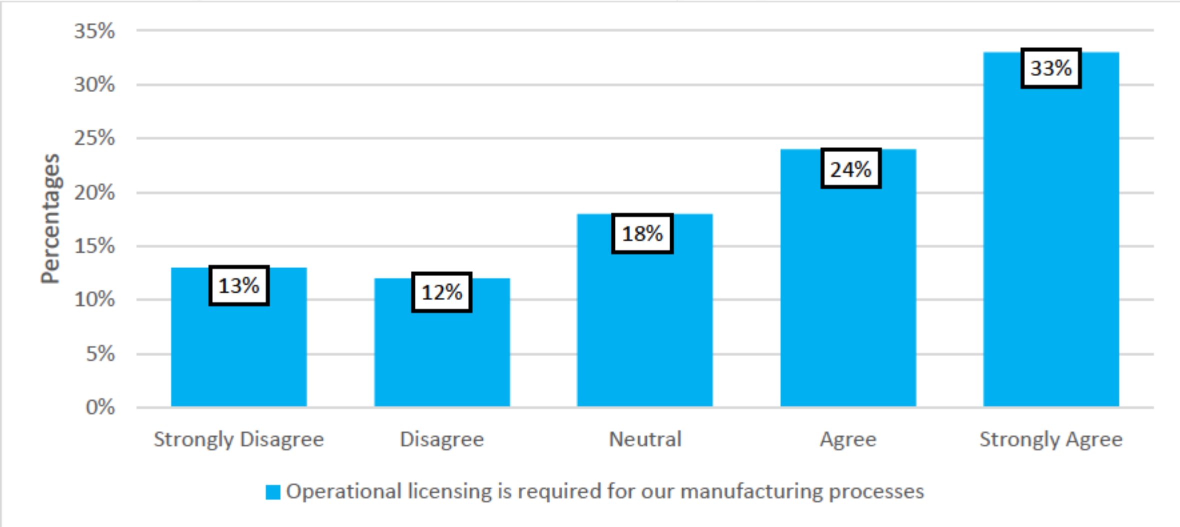


**Figure 4.39: Operational licencing**

#### 4.4.3.12 Summary of findings on Objective 3

This research identifies the aspects that have an impact on smart manufacturing. Competitive concentration has been identified as a factor that has a certain degree of influence on the adoption of smart manufacturing processes. Moreover, the impact of laws and regulations, such as environmental legislation, is relevent, as shown by the findings presented in Figure 4.31. Nevertheless, the findings indicate that the failure to embrace information technology hinders the business from completely implementing smart manufacturing practices. The findings of this research provide more evidence that the implementation costs of new technology

(Figure 4.33) and lack of financial resources (Figure 4.35) have an impact on smart manufacturing. In addition, the field of smart manufacturing is influenced by spatial constraints. The lack of acceptance of new technologies also has an impact on innovation inside these organisations. In addition to these concerns, there exists a deficiency in creative education and training.

### 4.4.4 Objective 4: To establish factors affecting the adoption of innovative leadership by SMEs pursuing smart manufacturing in Pietermaritzburg

The adoption of innovative leadership by SMEs in the quest to implement smart manufacturing practices is influenced by a number of factors. Seven items from Section E of the questionnaire were used in order to achieve this objective. The results are presented in Figures 4.40 to 4.46.

#### 4.4.4.1 Size of the business

Regarding the responses to the replies pertaining to Figure 4.40, it was found that a significant proportion of the participants (41%) expressed disagreement on the influence of company size on the adoption of innovative leadership, with 24% of respondents being neutral, while 35% expressed agreement. Based on the findings presented, it can be inferred that there is no discernible correlation between the size of a firm and the extent to which innovative leadership practices are embraced; smaller enterprises often experience quicker growth compared to larger, well-established firms (Mahlahla 2018: 188).

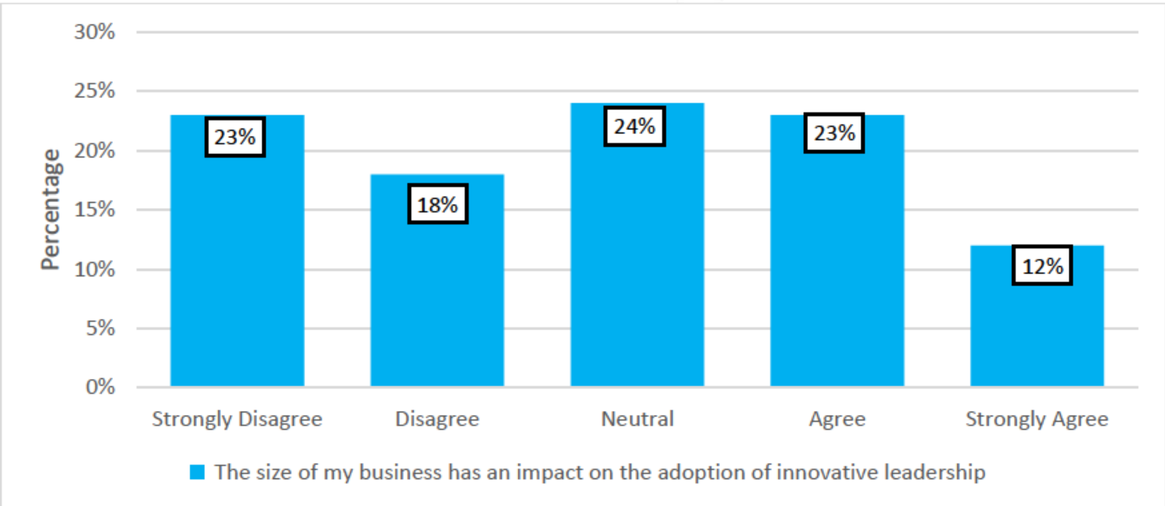


**Figure 4.40: The size of the business**

#### 4.4.4.2 Political and social pressures

The findings in Figure 4.41 show response to the effect of political and social pressures on innovative leadership adoption in the investigated organisations. The findings show that a total of 42% of the respondents were in agreement that there is an effect, while 31% disagreed, 27% neutral. These findings show that political and social factors do not really have a major influence on innovative leadership adoption in organisations. Therefore, external factors, including socio-political factors, do not necessarily drive smart manufacturing's adoption of innovative leadership. The legal framework under which small firms operate may be influenced by policy choices made by government organisations and politicians. Staying abreast of national and local political changes becomes a crucial element in the process of small firm planning and strategy formation (Jackson 2016: 223).

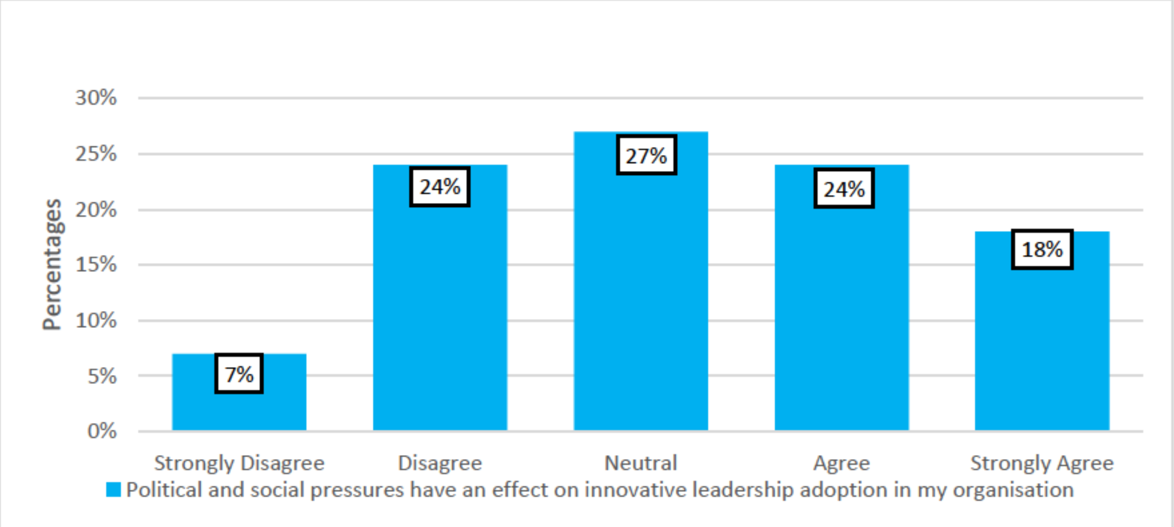


**Figure 4.41: Political and social pressures**

#### 4.4.4.3 Lack of technical skills

It is obvious from the results in Figure 4.42 that a lack of technical skills has an impact on the capacity to coordinate and manage the business. A total of 53% of the respondents are in agreement that a lack of technical skills affects their abilities to coordinate and manage business. Only 25% of the respondents were found to be in disagreement with the statement, while 22% remained neutral. From the findings, we can conclude that leaders need to be empowered with technical skills for them to be capable of managing and coordinating businesses innovatively. Lack of technical skills to handle production processes affects to the quality of performance of various occupations and gives direction to employees on how to carry out the procedures (Lebedev 2018: 563).

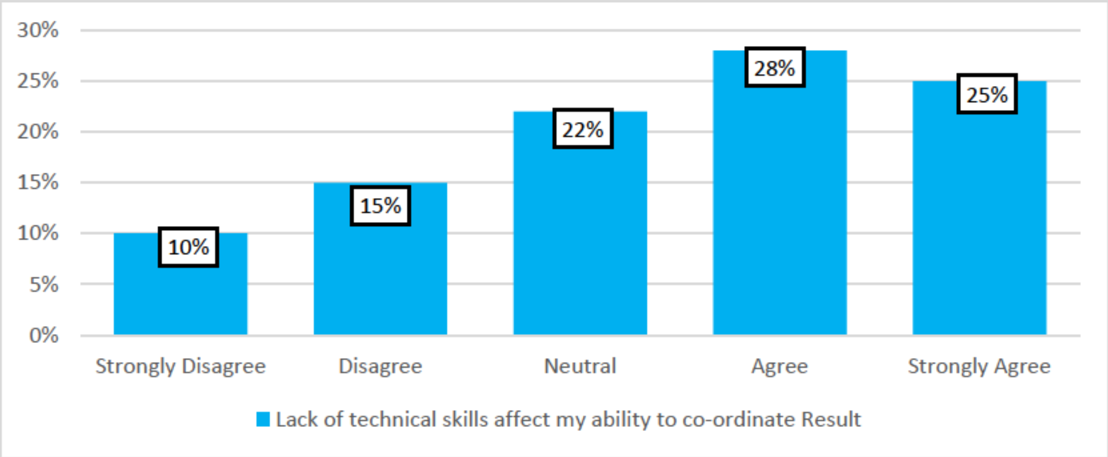


**Figure 4.42: Lack of technical skills to co-ordinate and manage**

### 4.4.4.4 Lack of technical skills to communicate effectively

According to the analysis in Figure 4.43, 45% of respondents agreed or strongly agreed that technical skills affect their ability to communicate effectively with staff. On the other hand, 31% disagreed or strongly disagreed with the statement, while 24% remained neutral. These findings sow that most participants were in agreement that technical skills affect their ability to communicate effectively with staff in their respective organisations. Pillay *et al.* (2016: 90) assert that lack of technical skills to communicate effectively leads to a lack of consistency and stability in work environments, creating an unsettled work atmosphere for workers.

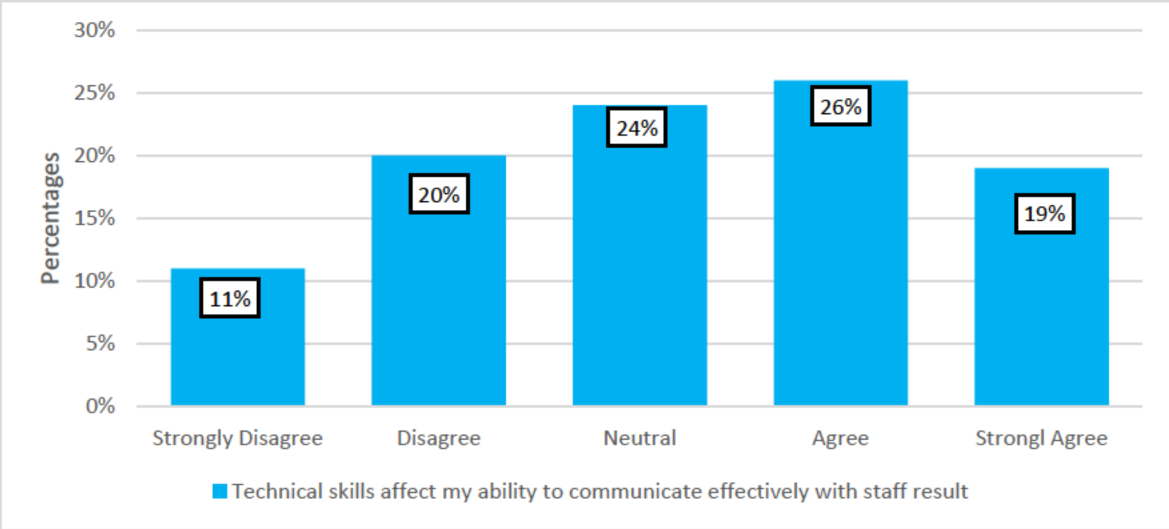


**Figure 4.43: Lack of technical skills to communicate effectively**

#### 4.4.4.5 Lack of government support

According to the data shown in Figure 4.44, a majority of respondents, namely 39%, expressed agreement with the notion that the absence of government assistance has an impact on the capacity for innovative leadership. Conversely, 33% of respondents indicated disagreement with this perspective. The remaining 28% maintained a state of neutrality. The findings indicate that insufficient government assistance has a discernible impact on the capacity for innovative leadership. Ngibe (2020: 186) confirms that the absence of financial assistance from the government as a significant element that affects innovative leadership.

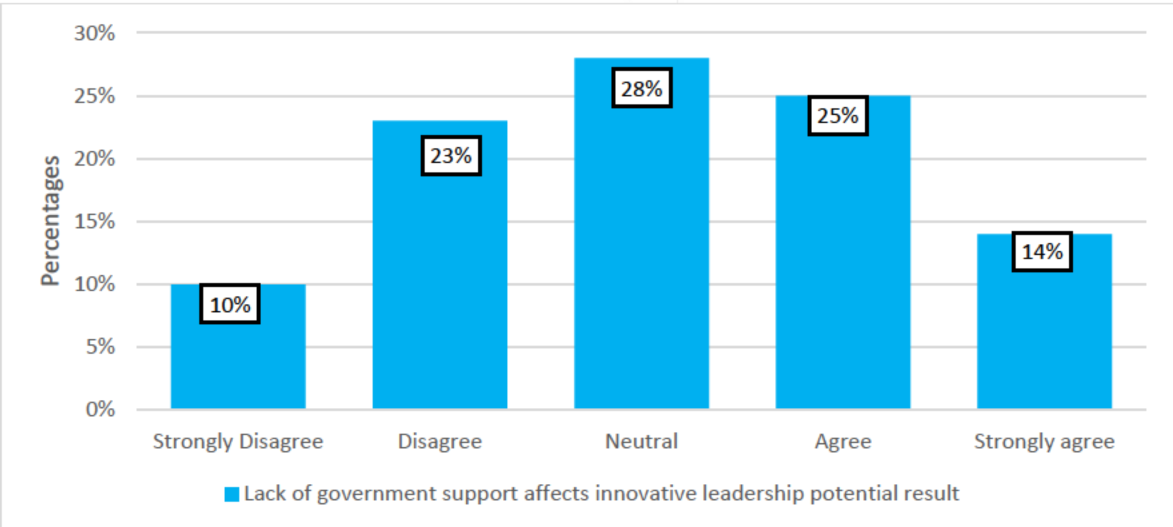


**Figure 4.44: Lack of government support**

#### 4.4.4.6 Lack of support from shareholders and/board of directors

According to the data shown in Figure 4.45, a significant proportion of respondents, namely 54%, expressed agreement or strong agreement with the impact of inadequate support from shareholders or the board of directors on Innovative leadership. The remark received disagreement and severe disagreement from 20% of the respondents each, while 26% expressed a neutral stance. The findings indicate that the absence of support from shareholders and the board of directors has a significant impact on innovative leadership, as corroborated by many surveys (Ayuba *et al.* 2019: 14).

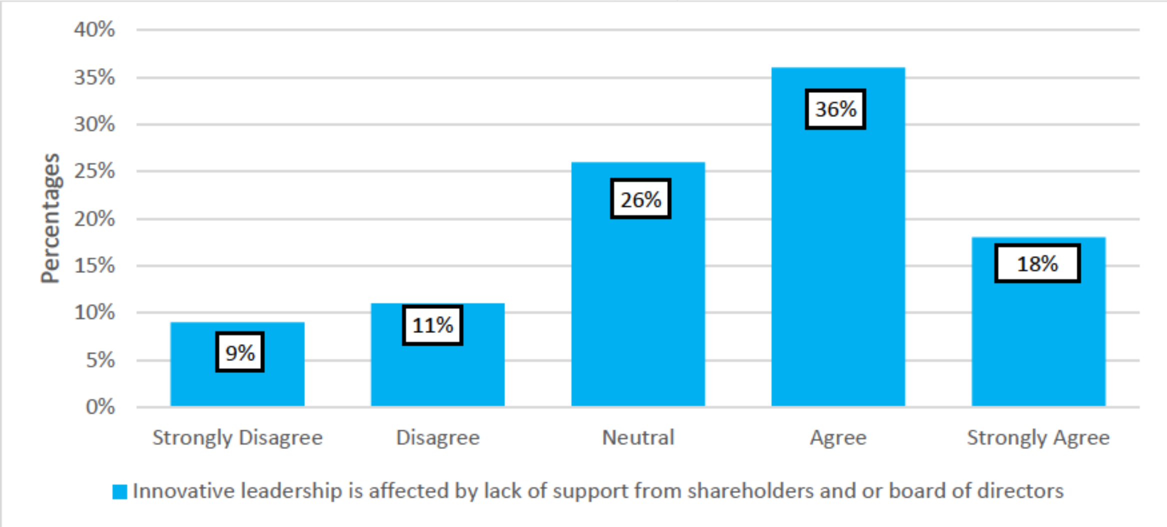


**Figure 4.45: Lack of support from shareholders and/or board of directors**

#### 4.4.4.7 Lack of educated and skilled employees

According to the findings shown in Figure 4.46, a majority of respondents, namely 58%, expressed agreement with the notion that the presence of uneducated and unskilled staff has an impact on innovative leadership. Seventeen percent of the participants expressed disagreement, while 25% maintained a neutral stance. The findings indicate that the presence of uneducated and unskilled people has a negative impact on innovative leadership. The industry and the broader economy are significantly impacted by the dearth of education and lack of a trained workforce, resulting in many effects such as decreased productivity and output, increased labour expenses, and diminished competitiveness (Gandhi, Thanki and Thakkar 2018: 623).

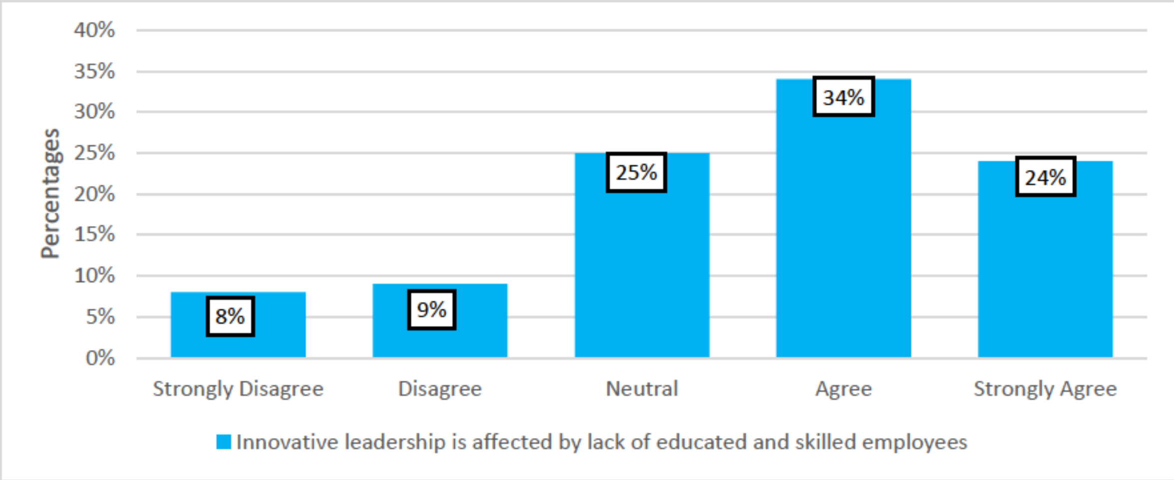


**Figure 4.46: Lack of educated and skilled employees**

### 4.4.4.8 Summary of findings on Objective 4

The findings show that a variety of factors influence SMEs' adoption of innovative leadership. The analysis revealed that there is no discernible correlation between the size of a corporation and its propensity to embrace innovative leadership practices. Additionally, the influence of political and societal forces on the adoption of innovative leadership was found to be minimal, as seen in Figures 4.40 and 4.41. The results of this research further demonstrate that a deficiency in technical skills has a detrimental impact on the capacity of SME executives to effectively coordinate and manage their firms in an innovative manner. Furthermore, the absence of governmental assistance has a detrimental impact on the capacity for innovative leadership. This research also found that a deficiency in technical skills hampers the capacity of SME leaders to communicate effectively with their personnel, as seen in Figure 4.43. The impact of a lack of support from shareholders or the board of directors on innovative leadership, as seen in Figures 4.45 and 4.46, is widely acknowledged. Similarly, the absence of educated and talented staff has been identified as a factor influencing innovative leadership.

## 4.5 CHAPTER SUMMARY

In this chapter, the results of the study are presented and discussed. It is possible to draw the following conclusions from the results: smart manufacturing processes are still in their infancy as used by SMEs in the Pietermaritzburg. The findings revealed that innovative leadership is present in the participant organisations, which helps the adoption of smart manufacturing. However, it was discovered that a number of factors, which were covered in detail in this chapter, had an impact on the use of advanced production techniques and innovative leadership.

The following chapter provides conclusions and recommendations concerning the adoption of innovative leadership in smart manufacturing by small manufacturing enterprises in Pietermaritzburg.

# CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

## 5.1 INTRODUCTION

The preceding chapter presented the data collected from respondent and discussed the findings in relation to the literature survey. This chapter elucidates the extent to which the study's aim and objectives were achieved and offers recommendations and further avenues for future research.

## 5.2 OVERVIEW OF THE STUDY

The primary objective of this research was to conduct a comprehensive analysis of the variables that impact the adoption of innovative leadership among SMEs in the smart manufacturing sector in Pietermaritzburg. Chapter 2 provided literature-based evidence with a focus on factors influencing the adoption of innovative leadership for smart manufacturing by SMEs. This chapter also presented an overview of the SME manufacturing sector in South Africa. According to Sahoo and Yadav (2018: 1140), as with other emerging nations, South Africa is dealing with socio-economic issues that need immediate action. A very high unemployment rate, a high percentage of illiteracy, a crime rate that is continually on the rise, and rural poverty are some of the obstacles that need to be overcome. Nguyen (2016: 18) notes that the prevalence of these problems is higher in areas that are more rural. As a result, SMEs should be given more authority so that they can contribute to the nation's effort to address some of these difficulties. SMEs in South Africa are highly diverse and participate in a variety of sectors, including retailing, wholesaling, tourism, mining, farming, manufacturing, construction, and service. Manufacturing SMEs in South Africa face similar growth and survival challenges to SMEs in other developing countries (Katambwe 2017: 746).

Furthermore, Chapter 2 unpacked the smart manufacturing challenges facing the South African SME manufacturing sector. SMEs in Africa face a plethora of challenges that limit their growth (Jane 2017: 2). This is reinforced by Sinsel (2020: 63) and Laitinen (2014) who affirm that, in addition to their beneficial role in growth, SMEs face a number of challenges that restrict their long-term survival. In order to be successful, small companies need resources and services. Kusiak (2018: 511) further adds that the future of South Africa's economy, which is now precarious, depends heavily on the local manufacturing sector, and the accessibility of smart manufacturing systems might determine how successful we are in the area and globally in the future.

The literature review chapter concluded by discussing the gap identified in the literature and the theoretical framework that was used in this study. In analysing factors affecting the adoption of smart manufacturing, leadership complexity theory was used as a theoretical lens for this research, while the resource-based perspective theory served as the study's theoretical foundation. Complexity leadership theory is a reaction to the demand for a new leadership strategy from a system perspective that addresses the complex interrelationships in the organisation as a consequence of the failure of traditional leadership to suit the requirements of contemporary companies. This theory promotes social capital leadership, which can be defined as management that enables workers to increase their level of confidence in the business. This, in turn, results in enhanced levels of productivity. The premise of shared leadership within the theory is trust, thereby reducing the likelihood of employees becoming sceptical about variations in the leader's actions. When seen through the lens of complexity, the fact that the conduct of leaders may be variable lends credence to the assertion that it is necessary to constantly adopt behaviour that suits the environment of the company in order to be flexible and progress towards the ultimate aim of the business.

## 5.3 ACHIEVEMENT OF THE OBJECTIVES OF THE STUDY

This section discusses how the aim and objectives of the study were achieved based on the supporting literature and the empirical findings of the study.

### 5.3.1 Objective 1: To determine smart manufacturing processes used by manufacturing SMEs in Pietermaritzburg

The main purpose of this objective was to ascertain the smart manufacturing techniques that manufacturing SMEs in Pietermaritzburg used. In attaining this objective, the following variables are discussed in conjunction with the findings of the study:

#### 5.3.1.1 Use of internet of things technologies in production process

The study found that the majority of respondents disagreed that IoT technologies were used in their particular firms' manufacturing processes. This indicates that IoT technology is not frequently used in manufacturing SMEs' production procedures. Manufacturing as a sector is in the midst of the fourth industrial revolution. Internet of things technologies are playing an important role in the shift of industrial practices from traditional to digital. Therefore, manufacturers who hesitate to make use of these new technologies are likely to less competitive. The objective of smart manufacturing is to maximise usable resource utilisation and process productivity in production by utilising information and communication technologies.

#### 5.3.1.2 Incorporation of artificial intelligence technologies in production processes

The finding is that many respondents disagreed artificial intelligence technologies were used at their company. Artificial intelligence aids in reducing machine downtime since intelligent systems predict maintenance needs. The reason for SMES not using artificial intelligence may be due to a lack of finances and expertise.

#### 5.3.1.3 Use of robotic technology in production processes

Conbsidering the majority of respondents who disagreed or strongly disagreed, this suggests that robotics technology is not being used in the production processes. This is challenging considering that robotic technologies are currently being used in manufacturing industries to improve manufacturing techniques and productivity. Manufacturing firms must adopt robots for welding, assembly, transportation, inventory management, and packing goods. Because of automation, robotics in manufacturing is being applied in a variety of fields and is efficient. Robotic applications in industry now require less time and cost to develop.

#### 5.3.1.4 Utilisation of cloud computing in production processes

The findings of this study showed that the majority of respondents agreed that cloud computing is being used in production processes. This result indicates that cloud computing is being used in production processes by many companies. Cloud computing is commercially viable for many SMEs due to its flexibility and pay-as-you go cost structure (Shivajee, Singh and Rastogi 2019: 117). Modern manufacturing can use data remotely because of cloud computing, which in some cases eliminates the requirement for on-premises infrastructure and software. Manufacturing firms use cloud computing software in their smart manufacturing setup to capture machine data and store it in the cloud for subsequent analysis.

#### 5.3.1.5 The production method makes use of organic-based material

The result of the investigation revealed that rspondents agreed that their production methods made use of organic-based materials. This is great in the sense that utilising smart manufacturing processes also translates to the adoption of smart materials, including organic-based biomaterials (Sekhametsi 2017: 89). This innovation, according to Ngibe and Lekhanya (2019a: 17-19), triggers the production of future goods. Several new materials necessitate innovative procedures that must be created and incorporated into smart manufacturing, and this can be a significant contributor to the quest for novel materials (Phuyal, Bista and Bista 2020: 18). In concluding the first objective, the study was able to determine smart manufacturing processes used by manufacturing SMEs in Pietermaritzburg and construct arguments by comparing the literature with the findings of the study.

In the organisations researched, adoption of IoT and artificial intelligence technologies is still quite low. The findings of this study also found that the usage of robotic technology among manufacturing SMEs is quite limited. The relatively low adoption percentage of these smart methods of production might be due to a lack of resources and abilities. It is worth mentioning that the cloud computing is frequently used by SMEs in industrial operations. Similarly, data collection from various sources is frequently used by manufacturing SMEs. Furthermore, the findings suggest that a sizeable number of SMEs in the manufacturing industry are implementing predictive engineering as an innovative approach for building high-fidelity models in their businesses. Based on the results of Objective 1, the overall conclusion is that the use of smart manufacturing processes by SMEs in the manufacturing industry is still in its infancy.

### 5.3.2 Objective 2: To analyse innovative leadership practices applied in manufacturing SMEs in Pietermaritzburg

To meet this objective, innovative leadership practices were investigated in manufacturing SMEs in Pietermaritzburg and further examined with the purpose of establishing the current challenges inhibiting the adoption of innovative leadership in Pietermaritzburg.

#### 5.3.2.1 Teamwork is emphasised in their company

The study reflected that most organisations place much emphasis on teamwork due to its benefits. Those who do not emphasise teamwork are slightly less than the majority. This is quite strange because teamwork falls under organisation culture, which looks at the organisation's leadership style, the way teams communicate, how it has adapted to new technology, how keen the company is to work together, and the firm's innovation mindset (Kane 2019: 45). The engagement of different people in collaborative endeavours often leads to the generation of novel and unique ideas. In the contemporary landscape of competitive business environments, the value of novel ideas is immeasurable. The presence of team members with varying ages, ethnic backgrounds, skill sets, and degrees of experience guarantees that each individual has a unique perspective that is readily available for consideration. The establishment of a safe atmosphere whereby workers can engage in collaborative teamwork without fear of criticism fosters the emergence of innovative ideas and perspectives.

#### 5.3.2.2 Individual responsibilities are clarified in our business

Role clarification is important since it guides and coordinates employees on work activities and makes sure they know what they are expected to do (Masocha and Fatoki 2018: 1264). This suggests that businesses have to design roles and make them clear so that there will not be confusion during operations. Defining roles and duties in a company is critical, even though it can be tough at times. Many individuals wear several hats, performing tasks that are outside the scope of their job description.

#### 5.3.2.3 Clear feedback is always provided to the employees

The findings show that organisations do give clear feedback to their employees. An organisation may give clear feedback to employees so that they are aware of how they have performed and can be motivated or correct their mistakes. Positive, polite, and non-threatening feedback should be given. Throughout the process of feedback, the person delivering feedback should stay cool and professional. Although adverse criticism is important and beneficial, it should be provided in private.

#### 5.3.2.4 Leadership in our company emphasises task orientation

Rozlan and Hashim (2018: 3) highlighted that task-oriented leaders are much more concerned with attaining goals for organisational success through defining, assigning, and guiding employees on how to carry out tasks. This type of leadership, which is directive, works to guarantee that deadlines are met. This kind of leadership differs significantly from relationship-oriented leadership, which prioritises the establishment of strong connections and emotional support for many purposes. Understanding the basic principles of task-oriented leadership may help one become a more effective leader or supervisor.

#### 5.3.2.5 Leadership in our company encourages initiative

These findings are in line with Lekhanya's (2015: 413) finding that the majority of SMEs are faced with a range of critical factors, including a lack of strong leadership amongst the owners or managers and limited corporate governance skills. Dlamini (2017: 3) also found that SMEs in South Africa (SA) face the challenge of limited managerial capabilities and a lack of staff training, which lends support to this. Organisations are continuously on the lookout for people with initiative and enthusiasm, i.e. those who demonstrate a genuine interest and desire to 'get on' and achieve things, as well as a willingness to try new and unusual ways to reach their objectives.

#### 5.3.2.6 Innovative problem solving is encouraged in their organisation

The findings reflect that organisations do understand and appreciate innovative problem-solving techniques by encouraging employees to implement them. These findings are supported by the work of Sahoo and Yadav (2018 :1129), who concluded that good leaders in smart manufacturing SMEs support staff skill development which then enhances employee involvement, particularly in creative activities. One of the major factors affecting corporate innovation is a lack of employee support and education. Complacency is a prominent obstacle to innovation, as individuals may find solace in adhering to familiar territories rather than embarking on uncharted sectors. One potential strategy for business executives to surmount this challenge is to use the expertise of creative team members and establish an environment conducive to innovation.

#### 5.3.2.7 My organisation trains employees on the process of creative idea generation

The study found that that SMEs agree that training is the best way to enhance employee's creative idea-generation skills. The findings back up previous research by Kahle *et al.* (2020: 46: 33) who state that manufacturing SMEs need skills and training to accomplish innovation and long-term growth. Higher-order thinking talents like inventing, producing, and analytical skills are currently in great demand. This tendency will continue as the need for new products, methods of operation, and technology grows.

Therefore, based on the findings of Objective 2, the overall conclusion is that there is evidence supporting innovative leadership practices among SMEs in the manufacturing sector. This allows these organisations to advance the smart manufacturing agenda through management. The practises of task orientation, encouraging initiative, and encouraging innovative problem-solving are most utilised in innovative leadership processes. Innovative leadership is present in the researched firms. The findings reveal that the focus placed on cooperation and the delineation of individual duties in the analysed organisations is modest. The findings of this study also reveal that providing clear feedback as a component of innovative leadership is very important.

### 5.3.3 Objective 3: To identify factors that affect the adoption of smart manufacturing processes by SMEs in Pietermaritzburg

The factors that affect SMEs in Pietermaritzburg's adoption of smart manufacturing processes were investigated. The goal was to find out what is holding back the adoption of innovative leadership in Pietermaritzburg.

This research identified the elements influencing smart manufacturing. These include competitive concentration, although it was found that this aspect had a minor impact on the adoption of smart manufacturing processes. Space constraints have an impact on smart manufacturing. It was also shown that SMEs' adoption of smart manufacturing is hampered by a shortage of capital. Insufficient new technology adoption also has an impact on innovation in these organisations. These challenges are exacerbated by a dearth of creative education and training.

#### 5.3.3.1 The adoption of innovative production processes in their organisation is motivated by rapid technological changes

These findings conclusively reflect that rapid technological changes and trends are key to the adoption of innovative production processes in organisations. The perceptions of technical progress as slow or progressive have been severely contrasted with the perception of technological change as quick, even disruptive, as in the adoption of innovative production processes. The rapid advancement and integration of new innovations have shown significant acceleration within recent years, but with notable differences in their acceptance throughout various regions worldwide, notably in less developed nations. The rapid advancement of technology has a profound influence on several dimensions of society, the economy, and culture.

#### 5.3.3.2 The company is affected by competitive concentration

The results of the study unequivocally demonstrate that a significant proportion of the participants see technological advancements as a crucial determinant in the adoption of manufacturing automation platforms (MAPs). It is essential that SMEs consistently enhance their MAPs in order to ensure compatibility with contemporary technologies and software. Due to evolving technology, competing standards, lowering of costs, and exceptional growth and variety in demand, the competition for market dominance in the smart manufacturing sector is extremely intense. A healthy market's competitiveness is essential for a well-functioning South African economy.

#### 5.3.3.3 Lack of funding affects the adoption of smart manufacturing processes

The majority of those who participated in the survey were of the opinion that the company for which they work provides them with a salary that is commensurate with their level of experience, level of education, and level of training. In addition to this, not many respondents were neutral with the above statement. Large-scale manufacturers are forgoing smart manufacturing since they perceive it as being too costly and the main cause of future losses. The majority of respondents acknowledged that a lack of funding has a huge impact on the adoption of smart manufacturing processes (Woldie, Laurence, and Thomas, 2018: 50). Eniola and Entebang (2016: 41) added that smart manufacturing faces a generally recognised problem of lack of access to money or credit as the new technology machines are costly.

### 5.3.4 Objective 4: To establish factors affecting the adoption of innovative leadership by SMEs pursuing smart manufacturing in Pietermaritzburg

To meet this objective, factors affecting the adoption of innovative leadership by SMEs pursuing smart manufacturing in Pietermaritzburg were further examined with the purpose of establishing the current challenges inhibiting the adoption of innovative leadership in Pietermaritzburg.

#### 5.3.4.1 The size of their business has an impact on the adoption of innovative leadership

Based on Figure ???, we can therefore draw the conclusion that there is no varying relationship between business size and the adoption of innovative leadership. Resistance to transformation, fear of failure, a lack of resources such as the size of the business, limits, leadership style concerns, promoting innovation with organisational objectives, and balancing stability and change are all obstacles for innovative leaders. Fortunately, leaders can take action to solve each problem.

#### 5.3.4.2 Political and social pressures have an effect on innovative leadership adoption in their organisation

These findings expose that politics and social factors have a key influence on innovative leadership adoption in organisations. This means that SMEs have to make sure that they keep track of political and social changes or trends in the areas in which they operate. Society can have a negative impact on an organisation's image, brand equity, or productivity, particularly if environmental activists draw attention to a company's bad sustainability record.

#### 5.3.4.3 Lack of technical skills affect the ability to co-ordinate and manage this business

From the findings we can conclude that leaders need to be empowered with technical skills for them to be capable of managing and coordinating businesses. Technical skills are essential in business and management since they enable a company to function more smoothly in managing its business. When a person has technical abilities, they are able to interact more effectively. Coordination seems simple, yet it may be hard for many people. Poor coordination may have a big influence on the efficiency of staff and outcomes. Controlling and coordinating operations is a key managerial duty.

#### 5.3.4.4 Technical skills affect the ability to communicate effectively with staff

The findings in this study depict that technical skills have an effect on a leader's ability to effectively communicate. The capacity to communicate, discuss, and learn ideas is referred to as communication abilities. They are the most significant soft talents that a good personality needs. The communication abilities required of every individual change depending on the scenario. Active listening, watching, speaking, responding to others, having a correct attitude, and presenting are among the abilities required. Effective communication is critical to a company's success. It is nearly impossible for your business to prosper unless you have staff with strong communication skills. Good team communication boosts productivity by 20% to 25%. They both contribute to the expansion of the firm and the employee.

#### 5.3.4.5 Innovative leadership is affected by lack of support from shareholders and or board of directors

The results from the data indicate that thre is a lack of support from shareholders, which can affect innovative leadership. Shareholders play a pivotal role in financing operations, controlling the business, and governance, so have a huge impact on innovation and invention (Owalla 2019: 77).

#### 5.3.4.6 Innovative leadership is affected by lack of educated and skilled employees

The quality of education in innovative leadership has a direct impact on innovative leadership abilities. Organisations ought to strive to educate their staff and encourage a wide range of skills. Sahoo and Yadav (2018: 1125) state that the success of an organisation is not vested only in the qualities of the leader.

The results of this research indicate that a variety of variables play a role in determining whether or not SMEs embrace innovative leadership. A lack of support from shareholders and/or the board of directors has an influence on innovative leadership. A lack of support from competent and well-educated workers also has an impact on innovative leadership. The findings of this study further show that a lack of technical skills affects SME leaders' abilities to coordinate and manage their businesses innovatively. It was discovered that there is no variable link between firm size and the adoption of inventive leadership, and that governmental and societal constraints have no influence on the adoption of innovative leadership. It was also shown that a lack of technical knowledge impairs the ability of SMEs executives to interact successfully with their employees.

## 5.4 RECOMMENDATIONS FOR MANUFACTURING SMEs

The following recommendations were derived from a careful consideration of the findings and conclusions of this study:

It is recommended that the owners, managers, and other decision-making stakeholders incorporate innovative leadership into their enterprises in order to effectively and efficiently plan, organise, and control their business operations. In addition, this study recommends that business owners, managers, and other relevant stakeholders place a greater emphasis on developing or acquiring new knowledge regarding innovative leadership and the adoption of smart manufacturing, particularly for those who have little or no knowledge of innovative leadership and smart manufacturing at present.

Regular follow-ups should be carried out by the owner or managers in order to identify any gaps that still require improvement in the adoption of innovative leadership and smart manufacturing processes. This will ensure that all staff are properly trained and have a better understanding of the significance of smart manufacturing processes.

The findings of this study indicated that manufacturing SMEs in the Pietermaritzburg area are not tapping into government interventions and other supporting agencies, which could be one of the causes of the low adoption rate of smart manufacturing processes and high business failure rate in the area. The study recommends, therefore, that business owners and managers register with government databases so that they can utilise the various support avenues that the government provides. These support avenues may include, but are not limited to, assistance with finance, training, mentorship, market access, technical support, networking, and other facilities.

## 5.5 LIMITATIONS

This study focused on the manufacturing SMEs located in the Pietermaritzburg area, and hence the findings revealed in this study were based on the views expressed by the respondents whose businesses were located in that area. In addition, the researcher met with difficulties during the data collection process, as some of the participants were not fully committed to returning the completed questionnaires on time. Therefore, the findings can only be generalised with caution to other manufacturing SMEs in other regions with other demographics since their characteristics may differ.

## 5.6 RECOMMENDATIONS FOR FUTURE RESEARCH

Based on the findings of the study, the following possible future research areas have been identified:

The study only focused on smart manufacturing SMEs and did not consider other sectors within the sphere of SMEs. Therefore, it is recommended that future studies encompass other sectors within the SME sphere and investigate the adoption of innovative leadership in those enterprises. The findings of this study revealed that innovative leadership is still a new phenomenon but is considered relevant and has been adopted by some manufacturing SMEs, especially given the rapidly changing environment. This suggests that a comparable study should be conducted to examine the relevance of innovative leadership to the business performance achieved in other sectors. The study employed a quantitative research method. Thus, it is proposed that another study could utilise a mixed-methods approach to gather a broader spectrum of data and expand the body of knowledge in this field.

## 5.7 CONCLUSION

Ideally, all business owners, managers, and decision-makers have a common objective, which is to maximise profits and increase stakeholders' value while ensuring the sustainable growth of the business. This means that these stakeholders need to adopt innovative leadership to improve and maintain their business performance. To remain relevant and constantly upgrade their manufacturing processes in the present ever-changing environment, it is important that they incorporate contemporary innovative leadership within their business strategies. This will help to enhance their business performance, strengthen their competitive edge, and improve their market value, allowing the business' stakeholders to formulate better strategies for ensuring sustainable growth and thus helping to reduce the currently unacceptably high business failure rate amongst these entities.

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# APPENDICES

## APPENDIX A: ETHICAL CLEARANCE

DUT
DURBAN UNIVERSITY OF TECHNOLOGY
INYUVESI YASETHEKWINI YEZOBUCHWEPHESHE

FACULTY OF ACCOUNTING & INFORMATICS

Faculty Research Office
Durban University of Technology
29 November 2021

Student: Sydney Dumisani Maphumulo
Student Number: 21347075
Degree: Master of Management Sciences in Administration and Information Management
Email: 21347075@dut4life.ac.za
Supervisor: Dr C.J. Nyide
Supervisor email: nyidec@dut.ac.za

**Dear Mr Maphumulo**

ETHICAL APPROVAL: LEVEL 2
Your email correspondence in respect of the above refers.
Your proposal for a Master of Management Sciences in Administration and Information Management, titled 'Factors influencing the adoption of innovative leadership for smart manufacturing by small and medium enterprises in Pietermaritzburg', was submitted to two ethical reviewers and they had the following queries:

1. The plan of activities is required to be updated.
2. Page 13, the Ethic option is not selected. The student should select the option Expedited review (minimal risk to humans, animals or environment).
3. The student is required to revise the Letter of Information, the letter is lacking information and is incomplete.

Please amend your documents as per their queries. Their decision was to resubmit to FREC chair for approval of changes

Kindest regards.

Yours sincerely

Dr Mogiveny Rajkoomar
FREC Chair
Faculty of Accounting and Informatics
Durban University of Technology
Ritson Campus
Durban, South Africa
4001

# APPENDIX B: LETTER OF INFORMATION

**LETTER OF INFORMATION**

**Title of the Research Study:**

Factors influencing the adoption of innovative leadership for smart manufacturing by small and medium enterprises in Pietermaritzburg

**Principal Investigator/s/researcher:**

Mr. Sydney D Maphumulo
21347075
**Qualifications**
National Diploma in Accounting
Bachelor Degree in Management Technology

**Co-Investigator/s/supervisor/s:** Dr C.J. Nyide (DBA)

**Brief Introduction and Purpose of the Study:**

The importance South Africa of Small Medium Enterprises s in South Africa, especially during the changing times of liberalization of trade, expansion of regional economic integrations and advances in information communications. The importance of leadership and innovation in ensuring sustainable growth and leadership performance in these SMEs. The critical role of SMEs in South Africa can be easily identified in their ability to penetrate new market and having creative ways to expand economies without only focusing on absorbing labour. Having highlighted the importance of the SMEs and their contribution to the economy, it is important that we also highlight how their growth and sustainability is maintained through the adoption and use of smart manufacturing processes and innovative leadership.

**Dear Participant**
I am currently registered for a Master's Degree of Management Sciences in Administration and Information Management the Durban University of Technology. This requires me to conduct a study on the Factors influencing the

adoption of innovative leadership for smart manufacturing by small and medium enterprises in Pietermaritzburg, thus I would like to invite you to participate in the research as outlined above.

**Outline of the Procedures**:

**Summary of the study**
Smart manufacturing is being embraced and adopted by many manufacturing companies globally. It guarantees a future of mass-generating surprisingly personalized merchandise through responsive independent manufacturing operations at a competitive cos. However, the development of smart manufacturing requires knowledge and capabilities that small and medium enterprises (SMEs) usually do not possess. Many manufacturing SMEs are threatened by different difficulties which primarily impact their ability and progress. The advance in the artificial intelligence, cloud computing, Internet of things has intense impacted manufacturing

**Research aim and objectives**

**Aim**
The main aim of this study is to critically analyse factors influencing the adoption of innovative leadership by smart manufacturing small and medium enterprises in Pietermaritzburg.

**The target population for the study will comprise the following:**
The large sizes of populations, researchers cannot conduct test in all individuals in population because it is costly and time constraint. According to Msunduzi Municipalit**y** 2020 Database, there are 142 registered SMEs in Msunduzi Municipality., The study will be targeting owners and managers of SMEs in the manufacturing sector operating in Pietermaritzburg, the capital city of KwaZulu-Natal.

The size of the population on the Msunduzi Municipality Database, this study will employ census sampling. Census sampling is the method of statistical enumeration where all members of the population form part of the study in order to provide adequate information whole population. Thus, all 142 manufacturing SMEs on the Msunduzi Municipality Database (2020) directory, operating in Pietermaritzburg will form part of the study. This study will be focusing on Pietermaritzburg Smart Manufacturing. The instrument of data collection will be in the form of a questionnaire. The questionnaires will be hand delivered, some will be sent via email.

**Risks or Discomforts to the Participant**
Not Applicable.

**Explain to the participant the reasons he/she may be withdraw from the Study:**
Your participation in this study is purely voluntary and there will be no consequences should you decide to withdraw.

**Benefits:**
A thesis will be published and made available as a piece of information to contribute to the selected field of study. The final dissertation will be share with participants on request.
**Remuneration:**
You will receive no monetary or any other form of remuneration.
**Costs of the Study**:
No costs are applicable to you.

**Confidentiality:**

*Anonymity, confidentiality*

For anonymity and confidentiality your information will be carefully stored by the researcher and finally be disposed in a responsible manner. The data collection tools will also not request for your personal details to protect your identities. Therefore, your confidentiality and anonymity will be demonstrated by requesting you to sign a consent letter prior to proceeding with the interviews. You will have a solemn right to participate and withdraw from the research inquiry. You will be given an assurance that the information would remain between the study supervisor and the researcher. The questionnaires will be kept by supervisor in the designated archives and after given period it will be shredded and destroyed.

**Results:**

The significant new findings developed from the research will be sent to Umsunduzi Municipality Chamber by request, for easy access by you and the thesis will be available in the Durban University of technology website, online and the link to the site will be shared with you.

**Research-related Injury:**
This is not applicable to the nature of the study. The researcher will collect data by the questionnaires will be hand delivered, some will be sent via email. This will be completely voluntary, at your convenience
**Persons to contact in the Event of Any Problems or Queries:** (Dr Nyide, Senior Lecturer and Research Coordinator, Nyidec@dut.ac.za) Please contact the researcher (0744800444.), my supervisor (**0338458804**) or the Institutional Research Ethics Administrator on 031 373 2375.
Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

# APPENDIX C: CONSENT LETTER

**CONSENT**

**Full Title of the Study:**

Factors influencing the adoption of innovative leadership for smart manufacturing by small and medium enterprises in Pietermaritzburg

**Names of Researcher/s:**

Sydney Dumisani Maphumulo

**Statement of Agreement to Participate in the Research Study:**

I hereby confirm that I have been informed by the researcher Sydney Dumisani Maphumulo, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number:

I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.

I may, at any stage, without prejudice, withdraw my consent and participation in the study.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

I understand that significant new findings developed during the course of this research which may Relate to my participation will be made available to me.

| | | | |
|---|---|---|---|
| **Full Name of Participant** | **Date /** | **Time Right** | **Signature** |
| **Thumbprint** | | | |

I, *Sydney Dumisani Maphumulo* herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

| | | |
|---|---|---|
| Sydney Dumisani Maphumulo | 29/11/2021 | |
| **Full Name of Researcher** | **Date** | **Signature** |
| | | |
| **Full Name of Witness (If applicable)** | **Date** | **Signature** |
| | | |
| **Full Name of Legal Guardian (If applicable)** | **Date** | **Signatur** |

# APPENDIX D: QUESTIONNARES

DURBAN UNIVERSITY OF TECHNOLOGY
INYUVESI YASETHEKWINI YEZOBUCHWEPHESHE

**SECTION A: BIOGRAPHICAL INFORMATION and PROFILE.**

***To respond to the questions below please mark with X in the appropriate space.***

What is your Gender? (X)

| | |
|---|---|
| Male | |
| Female | |

What is your Age category?

| | |
|---|---|
| 20 and less | |
| 20-30 years | |
| 30-40 years | |
| 40- and above | |

What is your position in the business?

| | |
|---|---|
| Owner/CEO | |
| Manager | |

How many years has the organisation been operating?

| | |
|---|---|
| 1 – 5 years | |
| 5- 10 years | |
| 10 years and above | |

How many employees do you have in your organisation?

| | |
|---|---|
| 1 – 50 | |
| 50- 100 | |
| 100 and more | |

Please indicate your highest level of education

| Certificate | Matric | Diploma | Honour's Degree | Master's Degree | PhD Degree | Other, please specify |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

What is the enterprise annual turnover?

| Less than R200 000 | R200 001-R1 000 000 | R1 000 001-R3 000 000 | R3 000 001-R6 000 000 | R6 000 001-13 000 000 | R13 000 001 and above |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

SECTION B: Smart manufacturing Processes used by Manufacturing SMEs.

**Please answer the following questions from 12 to 44 by placing a cross (X) to reflect your level of agreement to the statements.**

**1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = strongly agree**

| | *Strongly Disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| 8. The production process in my company is done using the internet of things technologies | 1 | 2 | 3 | 4 | 5 |
| 9. The production process in my company incorporates artificial intelligence technologies | 1 | 2 | 3 | 4 | 5 |
| 10. The production process in my company uses robotic technology. | 1 | 2 | 3 | 4 | 5 |
| 11. The production process in my company uses cloud computing | 1 | 2 | 3 | 4 | 5 |
| 12. The production method in my company uses organic-based material | 1 | 2 | 3 | 4 | 5 |
| 13. The production in my company uses biomaterial | 1 | 2 | 3 | 4 | 5 |
| 14. The greater collection of data from diverse sources is applied in my company | 1 | 2 | 3 | 4 | 5 |
| 15. Predictive engineering as a new paradigm of constructing high-fidelity model is used in this business | 1 | 2 | 3 | 4 | 5 |
| 16. The production process in my company uses smart manufacturing | 1 | 2 | 3 | 4 | 5 |
| 17. My organisation uses smart equipment in its smart manufacturing processes | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| 18. The production processes in my company uses the enterprise resource production | 1 | 2 | 3 | 4 | 5 |

**SECTION C: Innovative Leadership Practices applied in Manufacturing SMEs.**

| | *Strongly Disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| 19. Teamwork is emphasised in my company | 1 | 2 | 3 | 4 | 5 |
| 20. Individual responsibilities are clarified in our business. | 1 | 2 | 3 | 4 | 5 |
| 21. Clear feedback is always provided to the employees | 1 | 2 | 3 | 4 | 5 |
| 22. Leadership in our company emphasises task orientation. | 1 | 2 | 3 | 4 | 5 |
| 23. Leadership in our company encourages initiative. | 1 | 2 | 3 | 4 | 5 |
| 24. Innovative problem solving is encouraged in my organisation. | 1 | 2 | 3 | 4 | 5 |
| 25. My organisation trains employees on the process of creative idea generation | 1 | 2 | 3 | 4 | 5 |
| 26. My organisation actively documents new knowledge and skills developed by employees on the job | 1 | 2 | 3 | 4 | 5 |
| 27. A formal problem-solving process supporting innovation is supplied in my organisation. | 1 | 2 | 3 | 4 | 5 |
| 28. My organisation offers training to staff in order to develop innovative problem- solving skills | 1 | 2 | 3 | 4 | 5 |

**SECTION D: Factors that affect the adoption of Smart Manufacturing Processes**

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| 29. The adoption of innovative production processes in my organisation is motivated by rapid technological changes | 1 | 2 | 3 | 4 | 5 |
| 30. Smart manufacturing process in my company is affected by competitive concentration | 1 | 2 | 3 | 4 | 5 |
| 31. The adoption of smart manufacturing in my organisation is affected by a number of laws and regulations such as environmental law, intellectual property laws and labour law | 1 | 2 | 3 | 4 | 5 |
| 32. The lack of adoption of information technology limits my organisation from fully adopting smart manufacturing processes. | 1 | 2 | 3 | 4 | 5 |
| 33. Smart Manufacturing In my organisation is affected by new technology implementation costs | 1 | 2 | 3 | 4 | 5 |
| 34. Innovation is affected by limited/shortage of space | 1 | 2 | 3 | 4 | 5 |
| 35. Lack of funding affects the adoption of Smart Manufacturing Processes | 1 | 2 | 3 | 4 | 5 |
| 36. Lack of new technology's adoption is affecting innovation in my company. | 1 | 2 | 3 | 4 | 5 |
| 37. The application of International organisation standard (ISO standards) is required in my company in order to perform the production processes | 1 | 2 | 3 | 4 | 5 |
| 38. Smart manufacturing in my organisation is affected by lack of Innovative education and training | 1 | 2 | 3 | 4 | 5 |
| 39. Operational licensing is required for our manufacturing processes | 1 | 2 | 3 | 4 | 5 |

**SECTION E: Factors affecting the adoption of innovative Leadership by SMEs pursuing Smart manufacturing**

| | *Strongly Disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| 40. The size of my business has an impact on the adoption of innovative leadership | 1 | 2 | 3 | 4 | 5 |
| 41. Political and social pressures have an effect on innovative leadership adoption in my organisation | 1 | 2 | 3 | 4 | 5 |
| 42. Lack of technical skills affect my ability to co-ordinate and manage this business | 1 | 2 | 3 | 4 | 5 |
| 43. Technical skills affect my ability to communicate effectively with staff | 1 | 2 | 3 | 4 | 5 |
| 44. Lack of government support affects innovative leadership potential | 1 | 2 | 3 | 4 | 5 |
| 45. Innovative leadership is affected by lack of support from shareholders and or board of directors | 1 | 2 | 3 | 4 | 5 |
| 46. Innovative leadership is affected by lack of educated and skilled employees | 1 | 2 | 3 | 4 | 5 |

# APPENDIX E: TURNITIN REPORT

Factors influencing innovative leadership in mobilising small and medium enterprises (SMEs) towards smart manufacturing in Pietermaritzburg Sydney Dumisani Maphumulo

ORIGINALITY REPORT

| 12% | 11% | 6% | 5% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | Submitted to Durban University of Technology<br>Student Paper | 2% |
| 2 | www.msunduzi.gov.za<br>Internet Source | 2% |
| 3 | uir.unisa.ac.za<br>Internet Source | 1% |
| 4 | www.abacademies.org<br>Internet Source | 1% |
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| 6 | mobt3ath.com<br>Internet Source | 1% |
| 7 | aquila.usm.edu<br>Internet Source | <1% |
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# APPENDIX F: DATA STATISTICIAN CONFIRMATION LETTER

24 January 2023

TO WHOM IT MAY CONCERN

This letter serves to confirm that I, Bonginkosi Duncan Ndlovu conducted the statistical analysis for Sydney Maphulo. I am employed at DUT as la ecturer in the Statistics department and I also hold an MSc in Statistics. I captured the data onto SPSS programme, produced descriptive analysis with particular focus on frequency tables and bar charts .

I sincerely hope that this information will suffice for your purposes.

# APPENDIX G: EDITING CERTIFICATE

**DR RICHARD STEELE**
BA HDE MTech(Hom)
**HOMEOPATH**
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Practice No. 0807524
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Eastern Cape

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rsteele@vodamail.co.za
rsteele201@outlook.com

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**EDITING CERTIFICATE**

Re: **Sydney Dumisani Maphumulo**
DUT Master's dissertation: **Factors influencing innovative leadership in mobilising small and medium enterprises (SMEs) towards smart manufacturing in Pietermaritzburg**

I confirm that I edited this thesis and the references for clarity, language and layout. I returned the document to the author with track changes so correct implementation of the changes and clarifications requested in the text and references is the responsibility of the author. The intellectual content of the document is the responsibility of the author. I am a freelance editor specialising in proofreading and editing academic documents. My original tertiary degree which I obtained at the University of Cape Town was a B.A. with English as a major and I went on to complete an H.D.E. (P.G.) Sec. with English as my teaching subject. I was a part-time lecturer in the Department of Homoeopathy at the Durban University of Technology for 13 years and supervised many master's degree dissertations during that period.

Dr Richard Steele
**26 October 2023**
*per email*