Gordon Institute of Business Science
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Factors enabling Micro, Small and Medium enterprises within the manufacturing sector to adopt circular economy Interventions

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ABSTRACT

The South African manufacturing sector is strategic to the country's economic recovery and future development. In the value chains, the sector is located centrally in such a way that it can influence both down-production processes and upstream-consumption processes. Hence, in this context, it is a suitable industry to lead the transformation to a circular economy.

The manufacturing industry has been slow to adopt circular economy interventions, despite the many benefits of a circular economy. In addition, some have attributed the inability to adopt and implement such interventions and business models to barriers and challenges.

The study investigated factors that could enable small, micro and medium enterprises (SMMEs) within the manufacturing sector to adopt a circular economy using a qualitative approach and semi-structured interviews to explore barriers and factors that could enable SMMEs to adopt circular economy interventions.

From a socio-technical systems perspective, the study showed that most barriers, enablers and drivers for SMMEs to adopt circular economy interventions are related to the environment, specifically in the stakeholder dimension. As a result, the findings emphasise the government's critical role in creating an environment that supports circular economy adoption. Furthermore, the findings highlight the importance of collaboration with other stakeholders to acquire the necessary competencies and capabilities for implementing circular economy interventions.

The findings have practical implications for both the industry and policymakers. This context calls for the government to balance its multiple roles as enablers and enforcers. In this context, without cohesion and synergy within the government spheres, the developed policies or lack of policy implementation could result in undesirable consequences that favour linear economy models.

When considering circular economy initiatives, managers should realize that circular economy is not an individual company's initiative but requires the involvement of all stakeholders, including those external to the business. Thus, to fill the existing capability holes, they should consider collaborating with multiple stakeholders for complementary support.

KEYWORDS

Adoption, Circular economy interventions, Circular business models, Enabling factors, Implementation

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Philosophy in Corporate Strategy at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Name & Surname Signature

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter One: Introduction to Research Problem

1.1 Introduction

The chapter gives a synopsis of the circular economy and barriers inhibiting South African manufacturing sectors from adopting circular economy practices. In addition, the chapter highlights that the global and South African economy is predominantly linear through the use of the circularity index.

In addition, the chapter shows that South African manufacturing is overly dependent on fossil fuels and natural resources. Thus, the manufacturing industry could not guarantee the future supply of resources should the sector not adopt circular economy practices.

As such, it creates an argument that micro, small and medium enterprises within the manufacturing industry offer an opportunity to shape the path for circular economy and future development for South Africa, given its strategic position in the value chain.

This chapter outlines the research problem and provide evidence on the existing gap in adopting circular economy practices to explore the factors that could enable organisations to adopt circular economy practices from existing literature. Additionally, the chapter demonstrates the theoretical and business need for the study before concluding with its purpose, scope, and limitations.

1.2 Circular economy

Recently, circular economy emanated as a possible option for the linear economy (Kumar et al., 2019) and a foundation for sustainability with the ability to provide universal resolutions to persistent barriers created by the linear economy and current utilisation models (Chen et al., 2020). Thus, the circular economy offers a proposition to assimilate economic pursuit and environmental sustainability (Chen et al., 2020; Korhonen et al., 2018) by uncoupling energy consumption and resources from economic growth (Chen et al., 2020) through four main circular economy strategies of reducing, reuse, recycle and redesign (Sohal et al., 2022).

Transitioning to a circular economy requires adaptation to value creation processes, consumption and disposal of products (Vermunt et al., 2019). Therefore, businesses must reconsider their logic for value conception, capture and transfer processes (Lüdeke-Freund et al., 2018). Furthermore, align their business models with circular economy practices (Zuchella & Previtali, 2019).

Extant literature suggests that SMMEs, particularly those in emerging markets, are confronted with multiple barriers. Such barriers include a lack of (1) Financial or economic barriers (de Jesus & Mendonça, 2018; Govindan & Hasanagic, 2018), (2) Cultural barriers (de Jesus & Mendonça, 2018; Kirchherr et al., 2018; Patwa et al., 2021), (3) Institutional and regulatory barriers (de Jesus & M Mendonça, 2018), (4) Organisational barriers (Chowdhury et al., 2022; Kirchherr et al., 2018; Sharma et al., 2021), (5) Skills and Knowledge barriers (García-Quevedo et al., 2020; Nudurupati et al., 2022; Sharma et al., 2022) and (6) technological barriers (de Jesus & Mendonça, 2018; Govindan & Hasanagic, 2018; Mishra et al., 2022).

1.3 The circular state of the global economy

The circular economy (CE) is an encompassing concept that promotes value creation from waste while promoting responsible production through reducing and recirculating materials (Corona et al., 2019; Sharma et al., 2021).

However, over the years, global industrialisation has contributed to the generation of excessive waste (Halog & Anieke, 2021). Consequently, waste remains a global issue (Halog & Anieke, 2021). Therefore, a complete understanding of the overall progress of the circular economy will require quantifying products and services, also known as the circularity index (Corona et al., 2019).

According to Circle Economy (2022), the global circularity index has decreased since 2018. For the same period, recycling accounted for an estimated 8.6 Gt of resources compared to 92.0 Gt of extracted raw materials to meet societal needs (Circle Economy, 2022). Therefore, suggesting that the global economy is still predominantly linear.

As highlighted in the Circularity Gap Report 2020, “with business as usual, material extraction is projected to surpass between 180 Gt and 184 Gt by 2050” (Circle Economy,

2022, p. 9). Thus, perpetuating that current dominant linear economy models are unsustainable.

SMMEs constitute the majority of global firms and have the most significant aggregated environmental footprint (OECD, 2019). By adopting circular economy practices, It is possible for SMMEs to mitigate climate change, reduce greenhouse gas emissions, and valorize waste by turning it into value (Fazluddin et al., 2022). Therefore, this creates an urgent need to understand factors that could promote the mass adoption of circular economy interventions.

Driven by external environmental mechanisms and pressure, SMMEs are willing to adopt circular economy practices (Sohal et al., 2022). However, barriers to adopting a circular economy push these SMMEs to partially implement circular economy practices in favour of profits (Dey et al., 2020; Ormazabal et al., 2018; Sohal et al., 2022).

1.3.1 Status of Circular Economy in Developed Markets

After gaining prominence in 1960, the circular economy concept gained support from governments, non-governmental organisations, and academic institutions (Muchangos, 2022).

Additionally, the inclusion of the circular economy in international and cooperation development agendas resulted in countries in the global north and China incorporating circular economy into their plans, regulations and strategies. (Muchangos, 2022).

Subsequently, these countries invest in infrastructure and relevant technologies to support their circular economy strategies (Halog & Anieke, 2021). Subsequently, driving high uptake of circular economy practices in these countries.

According to the European Commission (2020), of the total 7.06 Gt of direct material (imports and natural extraction), an estimated 2.98 Gt of materials has been used. In addition, export accounts for 0.77 Gt with 3.31 Gt emitted to the atmosphere, through water channels or deposed in landfills as waste.

Although there is an improved usage of materials, in the short-term primary raw materials will continue to be the main way of satisfying the demand for raw materials resources (European Commission, 2020). This evidence supports the assertion that more work is

required to understand factors that could foster SMMEs to adopt circular economy practices.

Nonetheless, the European Commission has acknowledged the role SMMEs in the global value chains in the broader adoption of circular economy practices (European Commission, 2020). As such, the European Commission has been looking for ways to incentivise SMMEs to adopt circular economy practices (Katz-Gerro & López Sintas, 2019).

1.3.2 Status of Circular Economy in South Africa

The circular economy is not unique to South Africa (Godfrey, 2021). As a result of South Africa's socioeconomic challenges, end-of-life products are being repaired and reused (Godfrey et al., 2021).In addition, South Africa has recycled about 13% of grey water. Comparatively, since 2007, when the energy crisis began, renewable energy has contributed 11% of the total energy mix (Godfrey et al., 2021).

South Africa’s economy is predominantly export and commodities (minerals and metals) driven, with fossil fuels as the dominant source of energy production (Von Blottnitz et al., 2022). Thus, reliant on the consumption of natural resources to drive economic activities and exhibit linear economic characteristics.

Von Blottnitz et al. (2021) demonstrated that South Africa’s economy extracts 875 Mt while importing about 32 Mt of fossil energy carriers, nonmetallic minerals and biomass. Thus, of 902 Mt of total materials flow into the economy, 240 Mt is emitted as water vapour or other gasses, while 310 Mt is liquid and solid waste (Von Blottnitz et al., 2022).

Therefore, suggesting low materials usage to meet societal needs. Consequently, 7% of solid waste and 2% of the local stock are recycled (Von Blottnitz et al., 2021). Therefore, it highlights the urgent need for further research into factors that could enable manufacturing sector SMMEs to adopt circular economy practices.

According to Nahman et al. (2021), decoupling growth from resource use by enhancing circularity creates an opportunity to better manage future resource constraint risk and build resilience. Consequently, implementing circular economy practices could preserve South Africa’s economy against future resource pressures and the unpredictability of

international markets while unlocking socio-economic benefits associated with economic growth (Nahman et al., 2021).

1.4 Problem Background

In a linear economy, materials are extracted, traded, processed into goods and discarded as waste or emissions (European Commission, 2020). This extraction continues to threaten the planet's future - and our lives depend on it (Circle Economy, 2022). Nevertheless, future projections are grim as they indicate an accelerating trend of materials extraction to meet global societal needs (Circle Economy, 2022).

Thus, the linear economy model is unsustainable because of its heavy dependence on water, materials and energy (Fazluddin et al., 2022). Hence, a circular economy provides a practical framework for decoupling economic growth from material extraction (Circle Economy, 2022) and achieving sustainable development (Fazluddin et al., 2022). It is a resource-efficient and low-carbon economy that can create new jobs and businesses (Fazluddin et al., 2022).

According to The United Nations Department of Economic and Social Affairs (2021), the global population growth projection is likely to reach 8.5 billion in 2030. However, according to Ellen MacArthur Foundation (n.d.), "most of the population growth and economic growth in the next few years will happen in the 'global south' in regions such as sub-Saharan Africa". Thus, a likely increase in global consumption (Muchangos, 2022) unless businesses urgently adopt circular economy practices as a framework for value creation.

According to Godfrey (2021), South Africa is already feeling the impact of resource constraints, thus making sustainable resource use critical to South Africa's future development. As such, "transitioning [South Africa's economy] to a more circular economy is no longer an option or a 'nice-to-have'" (Godfrey, 2021, p. iii).

In this context, to harness the potential created by circular economy practices, all sectors of the economy must urgently implement circular economy strategies. Due to its high dependence on resources such as energy, water, and virgin materials, manufacturing has a high degree of vulnerability (Fazluddin et al., 2022).

Consequently, circular economy practices in manufacturing can have a significant impact on production processes as well as product life cycle scenarios (Fazluddin et al., 2022). Therefore, as a consequence, it has an impact on both the upstream and downstream economic sectors (Fazluddin et al., 2022).

1.5 Problem definition

Adopting circular economy practices is a challenging and complex process (Patwa et al., 2021; Vermunt et al., 2019), with multiple limitations that require consideration before realising global net sustainability (Korhonen et al., 2018). Recent years have seen a growing movement promoting a circular economy as an alternative to a linear economy (Fehrer & Wieland, 2021; Korhonen et al., 2018).

Despite this, significant barriers exist to enhancing circular economy implementation and scaling throughout the South African manufacturing sector (Fazluddin et al., 2022). In addition, many businesses are hesitant to invest in circular economy practices due to insufficient knowledge and scarcity of business cases (Fazluddin et al., 2022).

Holzer et al. (2021) demonstrated that stakeholder cooperation is one of the topical issues, while Barreiro-Gen & Lozano (2020) and Sohal et al. (2022) highlighted the need for greater stakeholder collaboration for CE implementation from the SME perspective.

As a result of stakeholder engagement, it was revealed that the involvement of all sectors of the economy is necessary for implementing the circular economy effectively, including the government, the private sector and supporting organisations in South Africa (Fazluddin et al., 2022). In addition, stakeholders' engagement highlighted the need for policy practices and rewards for circular economy adoption (Fazluddin et al., 2022).

Circular economy practices are mature in the manufacturing sector and implemented in specific industries; however, stakeholders have highlighted the scope for expanding and scaling across the sector and economy as a whole (Fazluddin et al., 2021).

However, in the Global South, there is resistance to implementing new resource recovery processes from the already dominant mechanical recycling methods towards emerging recovery approaches (Cook et al., 2022). Thus, creating further barriers for SMMEs to adopt circular economy practices and a need for more access to funding.

According to Fazluddin et al. (2022), significant barriers inhibiting the South African manufacturing sector from adopting circular economy practices include “a lack of awareness of circular economy practices and the associated business cases; cost of implementation and sustainable financing mechanisms; lack of appropriate skills; lack of case studies or demonstration projects; lack of available local markets for products and services” (p. 26).

Thus, there is an urgent need for further research to identify and examine factors that could enhance the adoption of a circular economy within the South African manufacturing sector to create a more sustainable economy.

1.6 Motivation for Research Study

1.6.1 Theoretical need

It is no secret that the circular economy concept has been gaining increasing international attention as an alternative to linear economy models all over the world. In recent years, a significant focus has been placed on understanding the factors (barriers and drivers) that influence organizations to adopt circular economy practices.

As Centobelli et al. (2020) highlighted, transitioning to a circular economy will require business models that promote responsible production and consumption and reduce natural resource consumption. As such, extant literature needs to explain how companies design their business models in line with circular economy practices (Centobelli et al., 2020).

On the other hand, Do et al. (2022) asserts that extant literature on circular economy has mainly focused on theoretical aspects and largely neglected the linkages between theory and practice in developing countries. Therefore, highlighting the need for further research on adopting circular economy practices in emerging markets.

Each country faces different barriers to implementing circular economy practices. This means further investigation is required at a micro level, as asserted by Patwa et al. (2021). Considering this, Patwa et al. (2021) suggests that future research should be conducted in developing countries in Africa and Mainland Southeast Asia, as empirical findings from these countries could contribute to the development of the circular economy.

Furthermore, to adapt their business models from the dominant linear economy models, organisations in developing countries must explore the factors that enable them to adopt circular economy practices. Hence, the proposed research topic is on identifying and explaining factors that can enable small, micro and medium enterprises within the manufacturing sectors in South Africa to adopt circular economy practices.

Using circular economy practices in emerging markets, this research aims to advance academic discourse and contribute further to circular economy knowledge. Furthermore, the study seeks to identify and explain factors promoting the adoption of circular economy practices by micro, small, and medium enterprises in the South African manufacturing sector.

1.6.2 Business Need

South African economy is predominantly linear and resource intensive. Thus, highly dependent on resource extraction, large throughput of materials, and raw materials export for further beneficiation, with very few resources re-entering the economy (Godfrey, 2021). This dependency on resources to drive economic growth places the country at risk of resource depletion, which could derail future developments (Godfrey, 2021).

Developing new markets requires the country's skilled industrial economy to be more productive and innovative (The World Bank, 2018). According to The World Bank (2018), South Africa's economy is constrained by commodity prices.

Therefore, to address some of the national challenges, such as high unemployment, poverty and inequality, South Africa needs to transition to a more circular economy while at the same time striving for a net-zero carbon emission economy. Thus offering South Africa an opportunity for “inclusive development… [for] a post-COVID economic recovery” (Godfrey, 2021, p. ii)

Since the 2008 financial crisis, South Africa’s economic growth has been declining, with an annual gross domestic product growth (GDP) of 1.7% between 2010 and 2019 (The World Bank, 2021). Similarly, in the last 20 years, the South African manufacturing sector has declined due to de-industrialisation (Fazluddin et al., 2021). Meanwhile, in 2017, the agricultural and mining sectors were the main drivers of GDP growth (The World Bank, 2018). According to the recent GDP growth data from StatsSA (2021), the mining sector

remains the main GDP driver, with 18.1% versus 1.6% contribution by the manufacturing sector.

According to StatsSA (2020), within the manufacturing sector, small and medium businesses contributed 24% of the turnover in the formal business sector. Thus a 6% growth in contribution compared to 2013 (StatsSA, 2020).

Despite the fact that the manufacturing sector contributes to only a small portion of the cumulative growth of GDP, it remains a major contributor to the emissions of greenhouse gases because it heavily relies on the use of fossil fuels to generate energy (Fazluddin et al., 2022). However, considering the strategic position of the manufacturing sectors in the value chain, the manufacturing sectors can support South Africa in reversing “pre-mature de-industrialisation trends” (p.13) more sustainably and inclusively (Fazluddin et al., 2021).

Thus, the sector can unlock opportunities by designing and producing circular resources and adopting circular business models that minimise consumption (Fazluddin et al., 2021). As such, organisations can address environmental and socio-economic challenges while harnessing new business opportunities and gaining competitiveness due to greater efficiencies and reduced manufacturing costs (Fazluddin et al., 2021).

1.7 Research Purpose Statement

The research aims to identify and explain factors enabling organisations to adopt circular economic practices. Furthermore, to contribute to the current development path and future vulnerabilities of the South African manufacturing sector.

Consequently, the manufacturing sector plays an important role in the economic recovery and future development of South Africa. Hence, the study aims to identify and explain factors that might enable South African micro, small, and medium manufacturing enterprises to adopt circular economy practices. Accordingly, the study aims to:

1. Identify and explain factors that could inhibit small, micro and medium enterprises within the South African manufacturing sector from adopting circular economy practices

2. Identify and explain factors that could enable small, micro and medium enterprises within the South African manufacturing sector to adopt circular economy practices, and
3. Identify and explain factors that could enable small, micro and medium enterprises within the South African manufacturing sector to adopt circular business models.

1.8 Scope and delineation of research

There have been wide-ranging barriers to adopting the circular economy. As a result, studies on the circular economy have primarily focused on its barriers, drivers, and opportunities. However, most of these studies have focused on supply value chains. Therefore, this study will primarily focus on the factors enabling small, micro and medium enterprises to adopt circular economy practices.

There has been a decline in the South African manufacturing sector for many years, resulting in job losses and a high unemployment rate. However, given the strategic position of manufacturing sectors in the value chain, as highlighted by the research from CSIR, adopting circular economy practices in this sector could catalyse economic recovery and future development in South Africa (Godfrey, 2021). In addition, it influences circularity in both downstream and upstream sectors (Fazluddin et al., 2022).

The scope of the research will focus on the South African manufacturing sector and its sub-sectors. The population will include micro, small and medium enterprises that have adopted or have yet to adopt circular economy practices for triangulation purposes. The study will offer adequate settings for transferability to warrant that the outcomes can apply to similar settings (Shenton, 2004). In this context, the transferability within the manufacturing sector.

1.9 Conclusions

Throughout this chapter, the global economy, developed countries, and South Africa were provided with an overview of what the circular economy means and how it relates to circularity. The global economy circularity index is 0.5% less than the 2018 circularity index. Therefore, suggesting that the global economy is still predominantly linear.

Additionally, the chapter pointed out the fact that the South African manufacturing sector is overly dependent on natural resources such as water, materials, and fuel generated by fossil fuels.

In addition, the chapter highlighted the role of manufacturing sectors as a catalyst for economic recovery and the potential threat the industry could face shortly should the sectors not adopt circular economy practices. Finally, the chapter highlighted barriers preventing the manufacturing sector from adopting the circular economy.

The chapter further established the academic and business need for research on identifying and explaining factors that could enable small, micro and medium enterprises within the manufacturing sector in South Africa to adopt circular economy practices.

The remainder of this research report is arranged in the following order: chapter two is devoted to reviewing the literature relevant to the research topic and establishing the research anchor for the topic. The research questions and research propositions will be established in chapter three.

Chapter four will discuss the methodology, epistemology and ontology, sampling for the study and justify the choice of the methodology and the sampling criteria. Then, chapter five will present the findings, discussion of the findings will follow in chapter six. Then, Chapter seven will present the conclusions, theoretical and business implications, limitations and proposed scope for the future research.

Chapter Two: Literature Review

2.1 Introduction

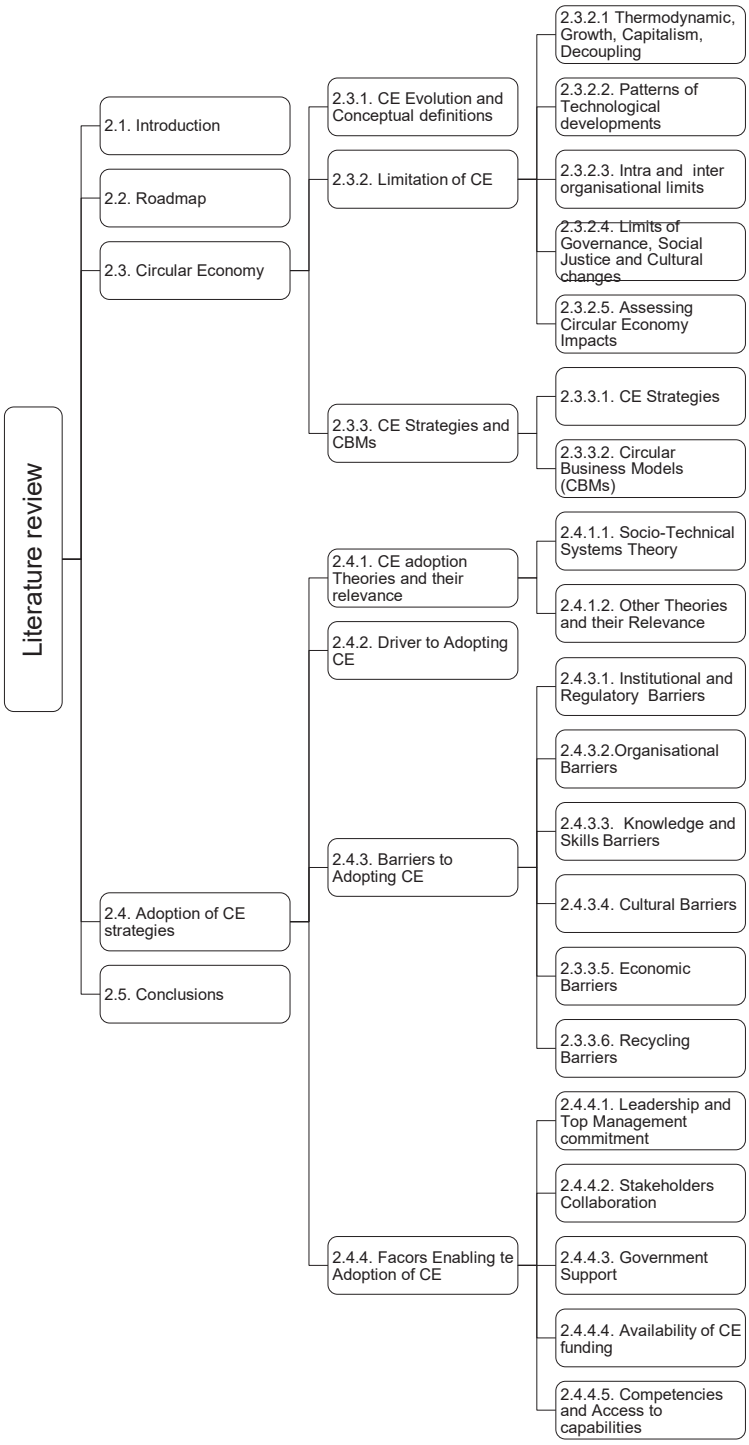
This chapter presents the arguments and further refines the problem statement for understanding factors enabling SMMEs within the South African manufacturing sector to adopt circular economy practices. Based on relevant and current academic literature, these arguments help clarify the research topic. Lastly, the chapter uses the roadmap (Section 2.2) to outline the logic and flow and concludes with the conceptual framework.

2.2 Road Map to Literature Review

The main topics and their respective subtopics to be covered in this chapter to advance arguments logically are presented in figure 1 below. A number of topics will be discussed in the chapter including: Circular economy - origins, concept, limitations; Adoption of circular economy practices - theories, barriers, opportunities, and critical success factors; and Adoption of circular economy practices in emerging markets - focusing on SMMEs in the manufacturing sector. Finally, the chapter will present the conceptual framework and overall conclusions.

Figure 1

Roadmap outlining the structure of the literature review



Note: created by owner

2.3 Circular Economy

Global industrialisation has accounted for large amounts of waste accumulated over the years in the planet's oceans and landfills (Halog & Anieke, 2021). Therefore, signifying a unidirectional production model where natural resources are consumed as input materials into production processes to produce goods purchased and disposed of after single use (Esposito et al., 2018).

These modes of production and consumption exhibit characteristics of the unsustainable linear economy, which has existed since the advent of the industrial revolution (Esposito et al., 2018). Thus, it requires the exploration of alternative production modes to meet the ever-increasing consumer demands while reducing the burden on the environment and society (Patwa et al., 2021).

Accordingly, the circular economy has gained global attention as one of the approaches to tackling environmental sustainability (Barreiro-Gen & Lozano, 2020). Furthermore, it has gained momentum as an approach to transitioning to a sustainable, low-carbon, resource-efficient, and competitive economy to serve as the necessary bridge to future economic growth (Garca-Quevedo et al., 2020; Govindan & Hasanagic, 2018). However, it should be noted that, despite all the benefits that can be gained from adopting circular economy initiatives, the adoption of such initiatives remains moderately low (García-Quevedo et al., 2020).

According to Journeault et al. (2021), it is necessary for SMMEs to receive more information about the benefits of sustainable practices so that they can incorporate them into their business activities and make them a key component of their business operations. Furthermore, due to a need for more research on successful circular economy implementation in the manufacturing sector, SMMEs need help integrating circular economy strategies into their business models (Marrucci et al., 2021).

Although scholars and practitioners comprehend that there are many ways in which the circular economy can be employed as a tool to solve persistent ecological challenges, the interconnections between circular economy business models and the organisational dimensions of the firm still need to be explored (Hofmann & Jaeger-Erben, 2020).

As asserted by Centobelli et al. (2020), the transition to a circular economy requires businesses to conceive novel value-creation models that consider sustainability and

contribute to reducing the consumption of natural resources. However, there is still a need for more information on how businesses design business models using circular economy doctrines and how to implement such models (Centobelli et al., 2020).

In addition, many scholars claim that the circular economy concept is vague, while others consider it an old concept with a new label (Pinheiro et al., 2022). Finally, scholars who critique circular economy principles argue that the concept has unclear theoretical backgrounds as well as diffused limits and that to implement it, structural barriers must be overcome (Corvellec et al., 2022).

According to Corvellec et al., 2022, even if the circular economy is marketed as a desirable model, it is far from being what it is. Thus, creating a research opportunity to elucidate circular economy adoption and implementation. In particular for SMMEs within the manufacturing sectors.

2.3.1 Circular Economy Evolution and Conceptual Definition

Despite the rising global popularity of the circular economy, the amount of scientific information and research relating to the circular economy as a concept is superficial and disorganised (Korhonen et al., 2018). Furthermore, it appears to be a collection of vague and different ideas drawn from various fields of study and semi-scientific concepts (Korhonen et al., 2018). Consequently, the idea needs to be clarified, with multiple definitions (Murray et al., 2017; Kirchherr et al., 2017; Korhonen et al., 2018; Korhonen et al., 2018a).

According to the literature, the circular economy concept may have originated from ecological economics (Murray et al., 2017), although there is some debate over its origins. Moreover, there are claims that other concepts like “eco-effectiveness” (Braungart et al., 2007), industrial ecology (Graedel, 1996), and industrial ecosystems (Korhonen et al., 2018) which business actors have created have all influenced the circular economy concept.

A circular economy can be conceptualised as reducing, reusing, and recycling activities (Kirchherr et al., 2017; Korhonen et al., 2018; Murray et al., 2017). Thus, reducing the demand for resources and energy compared to conventional recycling of low-grade raw materials (Korhonen et al., 2018).

However, this definition of the circular economy does not highlight that the circular economy requires a paradigm shift, nor are those business models and consumers enablers of the transition to the circular economy (Kirchherr et al., 2017). There is also a lack of discussion regarding the impact of the circular economy on social equality and future generations (Kirchherr et al., 2017).

While circular economy is an antonym to the linear economy and descriptively relates to the concept of cycling (Murray et al., 2017). Thus, providing the link between the circular economy and resource recycling by slowing or managing flux through biogeochemical cycles and recycling (Murray et al., 2017).

This concept was developed through a process called industrial symbiosis, which allows companies to share waste between themselves, while slowing down the cycles of use in the service economy in order to delay waste output (Bruel et al., 2019; Murray et al., 2017; Saavedra et al., 2018).

As proposed by Korhonen et al. (2018), to increase product longevity, materials should be received first, refurbished, repaired and then remanufactured before using materials as raw materials. Hence, manufacturing and maintenance are needed to reduce product replacement and resource consumption (Murray et al., 2017).

Thus, the associated economic and environmental benefits make business economic sense to keep the materials in the loop for as long as possible (Korhonen et al., 2018). In addition, these benefits should also guide SMMEs on the appropriate business models to adopt in line with their operations and market segments (Ferasso et al., 2021; Guldmann & Huulgaard, 2020; Mostaghel & Chirumulla, 2021).

As a result of this overly simplified definition of circular economy, the idea is perpetuated that adopting the circular economy isn't a complex process. As stated by Dey et al. (2020), a shift from a linear to a nonlinear supply chain represents a paradigm shift that is of profound significance.

Thus, proposing the involvement and cooperation of multiple actors and stakeholders within the ecosystem (Barreiro-Gen & Lozano, 2020; Nudurupati et al., 2022). Hence, a collaborative approach is required to implement circular economy strategies successfully (Gupta et al., 2019; Nudurupati et al., 2022).

On the other hand, Sohal et al. (2022) suggest that SMMEs need to navigate the social, technical and environmental issues in order for them to adopt and implement circular economy strategies successfully.

According to (Fehrer & Wieland, 2021), businesses are part of large societal and ecological systems; for a genuine transition to sustainability, businesses must manage the adaptive tensions between social mission, environmental steward and economic growth. As a result, circular business models play an essential role in transitioning from a traditional to a circular economy.

As asserted by Centobelli et al. (2020), for businesses to adopt a circular economy requires designing business models around the new conception of resource reduction and environmental preservation. First, however, the extant literature needs to adequately explain how companies should design these business models according to circular economy practices (Centobelli et al., 2020).

Due to this, SMMEs face several challenges, such as having a limited understanding of the nature, benefits, and effects of sustainability, being short of time and resources and lacking the necessary skills and expertise to implement a circular economy (Journeault et al., 2021; Marrucci et al., 2021; Nudurupati et al., 2022).

Considering the highlighted complexities of the circular economy, this necessitates a more inclusive definition focusing on economic and environmental benefits and societal challenges. In this regard, this research adopts the following definition;

> The circular economy is constructed from societal production-consumption systems that [maximise] the service produced from the linear nature-society-nature material and energy throughput flow. This is done using cyclical materials flows, renewable energy sources and cascading-type energy flows. [A] Successful circular economy contributes to all three dimensions of sustainable development. A circular economy limits the throughput flow to a level that nature tolerates and utilises ecosystem cycles in economic cycles by respecting their natural reproduction rates (Korhonen et al., 2018, p. 39).

According to Bruel et al. (2019), a circular economy draws on various schools of thought and is rooted primarily in industrial ecology (Bruel et al., 2019; Saavedra et al., 2018).

However, the concept of circular economy, requires revision and exploration of its theoretical foundations (Bruel et al., 2019; Figge et al., 2022).

For this reason, the industry continues to face ambiguities, inconsistencies, and contentiousness with respect to the definitions, objectives, and methods of implementing the circular economy (Friant et al., 2020).

Thus, various actors and sectors articulate different circular discourses to suit their interests while ignoring circularity's socio-ecological and political implications (Friant et al., 2020). This indicates a lack of agreement and convergence on the circular economy concept (Homrich et al., 2018; Schroeder et al., 2019)

As a result of the need for more clarity about the concept and how it can be implemented, SMMEs are becoming more hesitant to adopt circular economy principles—as such, leading to organisations not knowing whether what they have implemented is the circular economy or not (Prieto-Sandoval et al., 2018a).

2.3.2 Limitations of the Circular Economy concepts

As a paradigm shift towards sustainability, the circular economy signifies the most recent and advanced manifestation (Prieto-Sandoval & Ormazabal, 2018). As Friant et al. (2020) asserted, this promising concept could address sustainability challenges through regenerative and restorative production and consumption systems. However, a circular economy should be viewed as something other than a magic bullet for sustainability (Prieto-Sandoval & Ormazabal, 2018).

Like any emerging social construct, barriers and limitations are associated with these new concepts as they evolve and gain new knowledge. As demonstrated by Friant et al. (2020) and Korhonen et al. (2018), the circular economy is confronted with many barriers and limitations regarding environmental sustainability. For example, laws of nature do not allow for processes without waste and energy loss; as such, thermodynamics and systems boundary limitations need to be resolved for the circular economy to achieve global net-zero sustainability (Korhonen et al., 2018).

2.3.2.1 Thermodynamic limits, Growth, Capitalism and Decoupling

Besides the physical limits to recycling and recovery, the connection between the environment and society is governed by the second law of thermodynamics (Law of entropy) (Korhonen et al., 2018). However, as asserted by Friant et al. (2020), there still needs to be clarity on how entropy and laws of thermodynamics apply to the circular economy; thus, materials cannot be recycled indefinitely.

In the absence of economic regulation of the physical level of economic development, circular strategies such as reusing, refurbishing, remanufacturing, and recycling will eventually lead to unsustainable levels of pollution, waste generation, and resource exhaustion (Friant et al., 2020; Korhonen et al., 2018).

This supports the assertion by Friant et al. (2020) that a fully circular economy may be "illusionary as a perpetual motion machine" (p. 4). Moreover, as asserted by Korhonen et al. (2018), temporal design and launching of durable produce - a feature of the circular economy, may produce unexpected negative consequences. Thus, a conceptual tension is created between the circular economy and sustainability to create a more sustainable future.

On the other hand, circular economy advocates assess the concept as inherently sustainable (Korhonen et al., 2018) and could generate economic gains (Friant et al., 2020). As Friant et al. (2020) asserted, further research is needed to determine whether and how economic growth can be decoupled from environmental degradation in a circular economy. Accordingly, this claim needs to be clarified.

In this context, a fully circular economy is incompatible with the current linear economic systems, as capitalists cannot grow in a de-growth environment (Friant et al., 2020). Heikkinen (2020) concluded that absolute decoupling from resource use is not feasible against global economic growth. Subsequently, green growth or a circular economy may be misguided, and policymakers should consider alternative strategies Heikkinen (2020).

2.3.2.2 Patterns of Technological Development

Technological development patterns may also challenge overcoming path dependencies and lock-in (Korhonen et al., 2018). Thus, hampering a transition to a circular economy. In this regard, the first movers enjoying the economies of scale and learning effects may need help transitioning to a circular economy due to high switching costs for consumers and businesses (Korhonen et al., 2018).

Therefore, the circular economy has to compete alongside the dominant linear economy, making it difficult to break through in the market despite circular economy solutions being superior (Korhonen et al., 2018).

Furthermore, as with the disruptive nature of technology, circular economy models promoting prolonged use of products and materials may block a way to more efficient approaches (Korhonen et al., 2018).

Consequently, the capital involved in the circular model will likely lose value over time, resulting in the wasteful disposal of the goods produced (Korhonen et al., 2018). This is contrary to the regenerative nature of the circular economy.

2.3.2.3 Intra-organisational and Inter-organisational Limits

Other limitations include intra-organisational (firm) and inter-organisational (industry) objectives and strategies that seem consistent (Korhonen et al., 2018). For example, the drive to implement management systems. By their very nature, management systems focus on reductionism as their focal point, which is the firm and not the industry (Korhonen et al., 2018).

As such, it may prove difficult for firms to convince their stakeholders, consumers, and customers that waste maximisation benefits the environment and sustainability (Korhonen et al., 2018).

2.3.2.4 Limits of Governance, Social Justice and Cultural Changes

Extent literature has focused on the technological aspects of transitioning to a circular economy while sidelining the social and cultural dimensions (Korhonen et al., 2018) and, more significantly, governance and justice dimensions (Friant et al., 2020).

However, as Friant et al. (2020) asserted, governance and political considerations should be accorded greater attention in circular economy research, as power plays a crucial role in transitioning from a linear economy to a circular economy. In other words, the ability to know who makes the decisions and who benefits from them (Friant et al.,2020).

Korhonen et al. (2018) assert limited circular economy literature from social sciences and humanities. However, this needs to include the notion that the definition of materials flow is dynamic and depends on history, culture and social perspective.

Thus, the interpretation of materials flows as either a valuable resource or how materials flow should be treated will differ from country to country (Korhonen et al., 2018). As Kirchherr et al. (2018) demonstrated, barriers to the transition to a circular economy were primarily cultural.

Taking a circular economy approach requires transforming consumption and production structures from linear to collaborative, sharing, and value-based ones (Friant et al., 2020).

2.3.2.5 Assessing Circular Economy Impacts

There is no doubt that the transition to a circular economy will require evidence to support the development of policies and business strategies and to advance sustainable solutions as a priority (Corona et al., 2019).This necessitates a framework to quantify circularity for products and services (Corona et al., 2019) and assess a circular economy's full impacts (Friant et al., 2020).

According to Corona et al. (2019), such metrics are being developed for this purpose; however, they need to be more consistent in practice and substance. In addition, to

understand the organisation's contribution towards sustainability, circularity and longevity are required for sustainable materials use (Figge et al., 2018).

Further, there is insufficient research on other concepts, such as de-growth and non-western visions, that share similar objectives of transitioning towards regenerative socio-economic structures (Friant et al., 2020) and could advance to the sustainable deceleration of resource cycles (Homrich et al., 2018).

Thus, a limited alternative to circularity. Therefore, creating a challenge to appraise the full impacts of a circular economy (Friant et al., 2020) further contributes to the confusion and misapprehension of circular economy (Corona et al., 2019).

As highlighted by Manninen et al. (2018), the more significant challenge of these frameworks is the overstated environmental benefits gained from the environmental value propositions at the systems level.

Further, Heikkinen (2020) and Kjaer et al. (2019) argue that circular economy practices will only decouple economic growth from resource consumption if resource use declines, regardless of the growth rate of the economic driver. Therefore, this creates tensions about assessing and measuring the extent to which a circular economy has an impact (Friant et al., 2020).

Consequently, this contributes to a need for more adoption and implementation of circular economy practices. As Manninen et al. (2018) highlight, further research is required to advance environmental assessment frameworks for organisations adopting and implementing new circular business models.

Generally, it can be concluded that the circular economy concept does not have any connection with any economic or philosophical concept (Friant et al., 2020). Hence, the concept is challenged due to a need for convergence in the literature (Homrich et al., 2018) and limitations in understanding (Friant et al., 2020; Korhonen et al., 2018). In addition, current frameworks on circularity still need to fully elucidate how to measure and assess the full impacts of a circular economy on sustainability (Friant et al., 2020; Manninen et al., 2018).

It is widely acknowledged that the circular economy is intrinsically sustainable (Korhonen et al., 2018) and could generate economic gains (Friant et al., 2020), but other scholars

argue that economic decoupling from resource consumption is not always inevitable (Heikkinen, 2020; Kjaer et al., 2019).

Consequently, this lack of clarity creates uncertainty in organisations, resulting in organisational inertia to adopt and implement a circular economy, in particular, SMMEs, due to a lack of financial capacity (García-Quevedo et al., 2020; Journeault et al., 2021; Marrucci et al., 2021; Sohal et al., 2022; Sharma et al., 2021) and requisite skills (Journeault et al., 2021; Marrucci et al., 2021; Nudurupati et al., 2022) to adopt circular economy practices.

This results in opening a research gap that can provide an opportunity to advance the discussion about the implementation and adoption of circular economy principles in the future.

2.3.3 Circular Economy Strategies and Business Models

2.3.3.1 Circular Economy Strategies

Circular economy assimilates economic growth with environmental sustainability through environmental practices, technological innovation (Prieto-Sandoval et al., 2019) and the physical flow concepts in which the flows are reversed (Korhonen et al., 2018; Prieto-Sandoval et al., 2019).

Thus, advocating for the maximisation of the time spent by the resources in the system (Kalmykova et al., 2018; Korhonen et al., 2018). Subsequently, this would lead to better environmental outcomes compared to the present dominant linear economy (Korhonen et al., 2018) and eco-economic decoupling to avert ecosystem collapse (Friant et al., 2020).

As Kalmykova et al. (2018) asserted, many strategies exist to retain the materials in a closed-loop system. However, to realise circular economy benefits would require organisations to adopt circular economy principles and business models that extend product life cycles.

In addition, integrate the organisation with external stakeholders to share services and value co-creation (Friant et al., 2020)—in this context, gaining economic advantage and social prosperity while conserving natural resources (Prieto-Sandoval et al., 2021).

Thus, organisations should consider adopting circular economy strategies that support material recycling, manufacturing, and refurbishment of products to reduce the consumption of resources and energy (Kalmykova et al., 2018; Korhonen et al., 2018; Prieto-Sandoval et al., 2019), recycle, energy recovery and re-mine (Friant et al., 2020).

As asserted by Kalmykova et al. (2018) and Prieto-Sandoval et al. (2019), other strategies may also include product or service sharing systems (PSS) - focusing on selling services and performance instead of products (Kjaer et al., 2019) and industrial symbiosis and eco-parks (Homrich et al., 2018).

Accordingly, the circular economy concept (Figure 2)is established as one of the leading environmental strategies (the 3Rs): Reduce, Reuse, Recycle (Kalmykova et al., 2018; Prieto-Sandoval et al., 2019) and Recover (Kalmykova et al., 2018) are defined by reduced utilisation, reduced emission and reduced inefficiencies (Prieto-Sandoval et al., 2019). The circular economy concept can be broken down into six key areas of action that guide circular economy performance: take, make, distribute, use, recycle, and industrial symbiosis (Prieto-Sandoval et al., 2019).

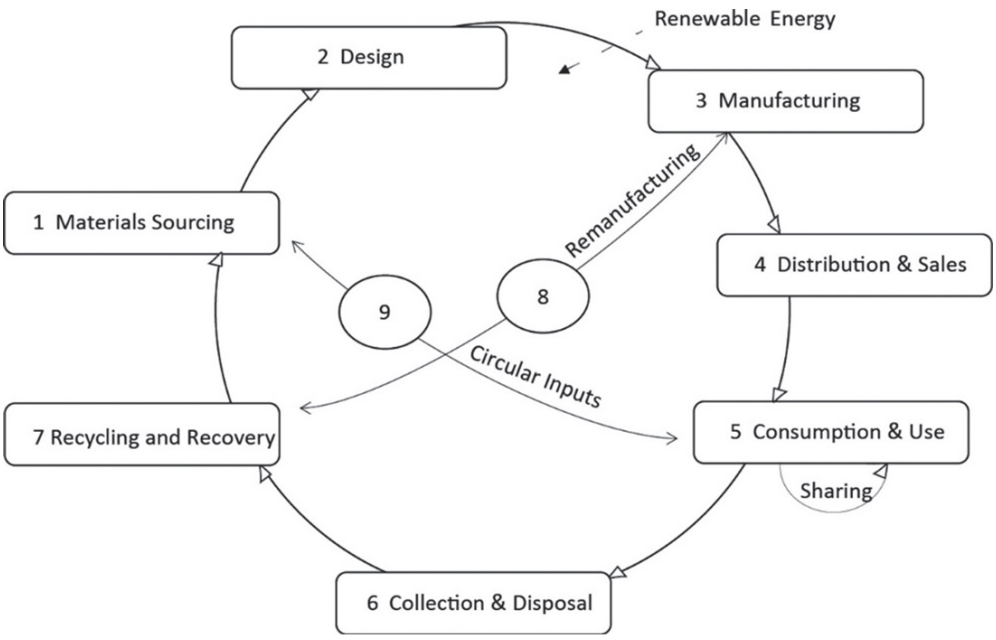
Depicted in Figure 2 below are various loops that characterise the value chain for the circular economy. Besides the main loop depicted by 1 to 7, other loops that exist are through remanufacturing (8), Circular inputs (9) and sharing under the consumption and use (5). According to Schroeder et al. (2019), remanufacturing presents process and product complexities that companies need to manage and require limited skills in some countries.

In addition, this requires a considerable effort to coordinate between retailers and consumers for effective collection and for retailers and suppliers to complete the cycle (Schroeder et al., 2019). Consequently, creating a challenge for small and medium enterprises to adopt such circular economy strategies (Schroeder et al., 2019).

Hence the dominance of recovery/recycling and consumption/use type practices compared to manufacturing and distribution parts of the value chain (Kalmykova et al., 2018).

Figure 2

Resource flow through a circular economy's value chain.



Note: Reprinted from "Circular economy – From review of theories and practices to development of implementation tools" by Y. Kalmykova, M. Sadagopan and L. Rosado, 2018. Resources, Conservation & Recycling, 135, p. 193. Copyright 2017 by The author(s).

2.3.3.2 Circular Economy Business Models (CBMs)

Since a circular economy can have a significant impact on sustainability (Manninen et al., 2018), according to academics and practitioners, ecological and socio-economic problems can be solved by circular business models (Hofmann & Jaeger-Erben, 2020).

As such, multinational and small and medium enterprises are cognizant of such benefits and are exploring circular business models as an alternative (Schroeder et al., 2019). Despite the correlation between circular business models and organisational dimensions, circular business innovation processes remain to be explored due to their limited scalability (Hofmann & Jaeger-Erben, 2020), scattered and fragmented (Chen et al., 2020).

While social and circular business models are essential to advance socio-economic and environmental issues, their adoption is somewhat discouraging (Fehrer & Wieland, 2021). Fehrer and Wieland (2021) asserted that current research on circular business models attributes low adoption rates to organisational innovation failures. Similarly, Centobelli et al. (2020) believe the existing literature should be clarified to understand how firms can create these novel business models per the principles of the circular economy.

There is therefore a limited understanding of how circular business models can be designed and implemented, which supports the view that these concepts are underdeveloped. In this context, Schroeder et al. (2019) assert that circular business models are challenging to create and administer.

To succeed in the transition to a circular economy, organisations must rethink and redesign their business models to incorporate circular economy doctrine into their value propositions (Centobelli et al., 2020; Manninen et al., 2018).

Consequently, introducing technological, disruptive, and new business models encourages “longevity, renewability, reuse, repair, upgrade, refurbishment, servitisation, capacity sharing and dematerialisation” (Esposito et al., 2018, p. 5).

However, this creates barriers for businesses and policymakers on how to deal with supply chain stakeholders that are likely to lose out due to circular business models and create organisations that facilitate the adoption of a circular economy (Esposito et al., 2018). Subsequently, organisational inertia transition adopts circular business models (Esposito et al., 2018; Hofmann & Jaeger-Erben, 2020).

It has been noted by Hofmann & Jaeger-Erben (2020) that inertia results from an inadequate understanding of the theoretical and practical aspects of circular business models. According to Yamoah et al., 2022, this is due to a lack of coordination between sectoral and supply chain partners and to business leaders not being convinced by short- and medium-term business cases. Therefore, this highlights the complexity of the transition process, which requires consideration of multiple factors.

As evidenced by Marrucci et al. (2021), small to medium enterprises grapple with assimilating circular economy approaches into their business models. Consequently,

more research needs to be conducted on the frameworks that facilitate how small and medium enterprises implement the circular economy (Marrucci et al., 2021).

Accordingly, Kirchherr et al. (2018) concluded that, at present, the circular economy is a niche conversation among sustainable development practitioners and that a substantial effort is desirable for the concept to sustain its thrust.

Therefore, alluding to the need for more research to advance the discourse on circular economy and its implementation. Furthermore, although the circular economy has been researched in large organisations, research on small and medium enterprises still needs to be conducted (Dey et al., 2020).

2.4 Adoption of Circular Economy Strategies

The circular economy (CE) is an encompassing concept that promotes value creation from waste while promoting responsible production and consumption to attain sustainability goals (Sharma et al., 2021) - through balanced assimilation between the economy, society and environment (Betancourt Morales & Zartha Sossa, 2020; Rovanto & Bask, 2021).

Thus, firms should consider multiple actors and their possible interactions within the system (Fehrer & Wieland, 2021). Consequently, making the adoption process is complex and challenging as it requires the involvement of multiple actors (Dey et al., 2020; Patwa et al., 2021; Sohal et al., 2022).

As previously demonstrated, there are critical enablers to adopting circular economy principles and, thus, a bridge between a company and systems-level thinking (Rovanto & Bask, 2021). However, organisations must have a unified understanding of how circular economy propositions can be configured and implemented effectively (Centobelli et al., 2020; Rovanto & Bask, 2021).

Meanwhile, Lüdeke-Freund et al. (2018) assert that insufficient research focuses on circular business models, while Betancourt Morales and Zartha Sossa (2020) argue that circular economy adoption frameworks are incomprehensible, particularly for SMEs.

In addition, it provides a valuable opportunity for researchers to examine business models' role in SMEs adopting circular economy practices as they strive to become more sustainable (Rovanto & Bask, 2020). On the contrary, most of the studies on circular economy adoption have primarily focused on large firms in developed economies (Dey et al., 2020; Sharma et al., 2021).
However, Patwa et al. (2021) concluded that the circular economy adoption process could vary from country to country due to differences in culture and consumer behaviour, variations in resource availability and varying government policies.

Thus, barriers and drivers towards adopting circular economy principles could also vary. On this assertion, Patwa et al. (2021) offer future research on adopting the circular economy by SMEs in other countries in Africa and Mainland Southeast Asia.

This section will discuss circular economy adoption theories and their relevance. It will be followed by factors affecting the adoption of the circular economy. These factors encompass, for example, the factors that drive the adoption of the circular economy and the barriers blocking it. The section will end with a summary of the critical success factors involved in implementing the circular economy. In addition, it will provide an overview of the overall synthesis of the process of adopting circular economy interventions.

2.4.1 Circular Economy Adoption Theories and their relevance

During the last decade, the circular economy and its goals have progressively been described and ascended to strategic topics in many governments and institutions worldwide (Ciliberto et al., 2021). However, despite this keen interest and the rise in prominence, the concept still needs to be adequately theorised and developed (Figge et al., 2022).

A further limitation of the existing literature is the absence of empirical evidence from developing countries confronted with insufficient institutional capacity and sustainability challenges (Jabbour et al., 2020). As such, the adoption of circular economy models persists to be impacted by multiple barriers and unfavourable factors that make the transition challenging (Ciliberto et al., 2021).

Multiple scholars have undertaken empirical research from different theoretical lenses to fill these gaps. This section will discuss Socio-technical theory and other theories relevant to adopting circular economy strategies.

2.4.1.1 Socio-Technical Systems (STS) Theory

In organisational behaviour, organisations are complex, involving a variety of interdependent subsystems that interact to generate performance (Ulan et al., 2022; Sony & Naik, 2020). As asserted by Walker (2015), the outcome of the organisational performance depends upon these interactions.

Taking the perspective of internal elements like tools and machines rather than focusing on the entirety of the system, as stated by Sony and Niak (2020), will not ensure a more holistic view of the overall system. As a result, to understand the organisation's system performance, the organisation must be studied as a whole, including elements such as people, culture, and technology (Ulan et al., 2022).

Griffith and Dougherty (2002) also assert that recognising the interaction between technical and social factors has become part of a trend among researchers and managers who recognise these factors' impact on organisational results. Thus, arguing that the interrelatedness between social and technical factors influences an organisation's performance (Walker, 2015).

In accordance with this model, an organisation consists of social systems (people) and technical systems (tools, techniques, knowledge) that are used to produce goods and services that are sold to customers outside the organisation (Griffith & Dougherty, 2002).

Compared with the technical system, which consists of technology, innovations, knowledge, and processes, the social system consists of structures, people, relationships, organizations, incentives, and performance measurements (Siawsh et al., 2021; Münch et al., 2022). The theory explains how people, technology, and organisational outcomes interact to produce the desired results (Griffith & Dougherty, 2002).

For effective systems to be designed or changed, social and technical factors must be considered (Münch et al., 2022). Therefore, STS theory is suitable for understanding how SMMEs in the manufacturing sector implement the circular economy. Thus, STS theory provides a framework to view organisations from a socio-technical perspective in the environment in which SMMEs operate.

Initially developed by Trist and Bamforth (1951), the framework has evolved from only dealing with four interaction dimensions of people, tasks, structure, and technologies to dealing with a six-dimensional interconnected network (Münch et al.; 2022). Figure 3 shows the dimensions of the external environment, including stakeholders, economic conditions, regulatory frameworks, and internal organisational factors (Davis et al., 2014; Münch et al., 2022).

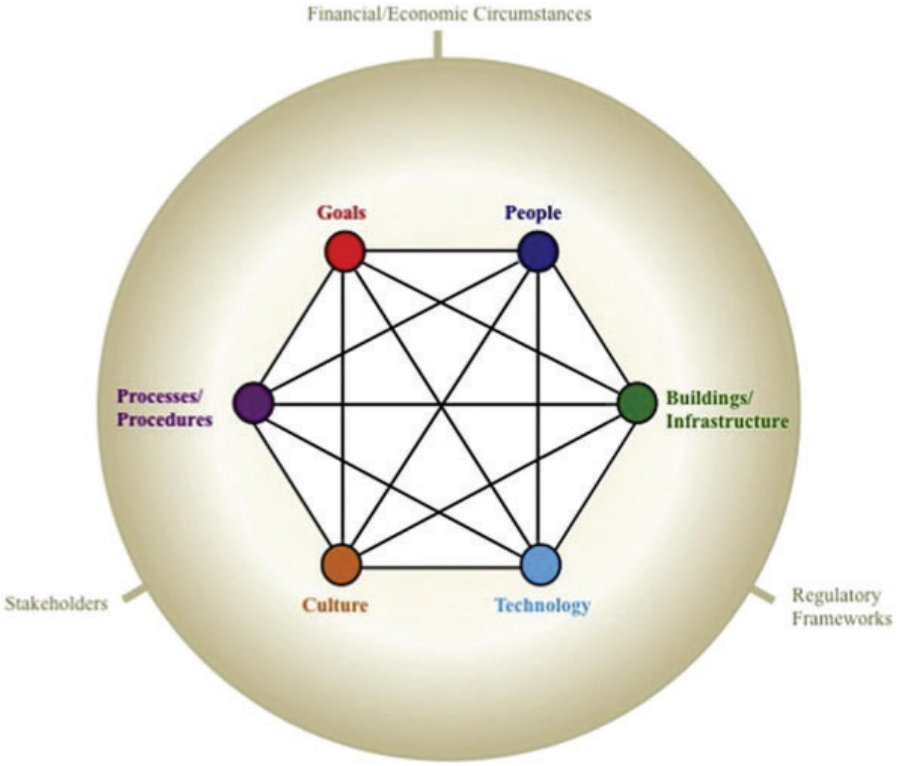
Kapoor et al. (2021) have applied the framework to understand complex interdependencies between multiple platform-orientated actors. Similarly, Sohal et al. (2022) applied STS to gain insights into social, technical and environmental factors on manufacturing SMEs towards a transition to a circular economy.

STS is considered the most advanced theory on the design and redesign of work and organisations (Mitki et al., 2019). At the same time, Sohal et al. (2022) assert that STS can be more practical for transitioning to a circular economy, given the dynamic competitive environment.

According to Davies et al. (2017), there has been a broad acceptance that social and technical systems interactions have a practical application to organisational change, especially in the context of change management.

Figure 3

The socio-technical system illustrates an organisational system's interrelated nature embedded within an external environment.



Note: Reprinted from “Advancing socio-technical systems thinking: a call for bravery” by M. C. Davis, R. Challenger, D. N. W Jayewardene, and C. W. Clegg, 2014. Applied Ergonomics: Part A, 45(2), p. 173. Copyright 2013 by Elsevier Ltd and The Ergonomics Society.

2.4.1.2. Other Theories and their Relevance

Various scholars have undertaken empirical studies into adopting the circular economy by applying various theoretical frameworks. These theoretical frameworks range from institutional theory (DiMaggio & Powell, 1983) to Absorptive Capacity Theory (Zahra & George, 2002). A summary of these theoretical frameworks of the sampled studies (Table 1).

Table 1

Summary of the sampled studies on theories used to gain insight into adopting the circular economy.

Theory	Sampled Studies and Authors
Institutional Theory (DiMaggio & Powell, 1983).	Investigation into the role of institutional pressure and its effect on adopting big data analytics to adopt circular economy practices and capabilities Bag et al. (2021).
	To identify factors that could enable or inhibit firms from implementing circular economy strategies and factors that lead to firms being isomorphic (Do et al., 2022).
The Resource-Based Theory (Barney, 1986)	To investigate how firms reconfigure their resources and capabilities to adopt circular economy strategies while maintaining their competitive advantage (Nudurupati et al., 2022).
Dynamic capabilities theory (Teece, 2007)	Assessing the essential capabilities in innovation, experimentation and development and stakeholder connections in conceptualising waste (Wade et al., 2022).
Stakeholder Theory (Freeman, 2008)	The transition to a circular economy, the role of multiple stakeholders and their interrelations with the organisations. Through Stakeholder theory, scholars have gained insights into the positive role of pressure from suppliers (Pinheiro et al., 2022) and government and business rivals (Kitsis & Chen, 2021).
Change Management Theory (Lewin, 1947)	Using Change Management theory, researchers have studied the complex interactions between technical and behavioural aspects of organizations transitioning toward the circular economy (Malik et al., 2022). Transition management for circular business models (Hofmann & Jaeger-Erben, 2020) and frameworks for addressing circular economy requirements (Bertassini et al., 2021)
Absorptive Capacity Theory (Zahra & George, 2002)	Marrucci et al. (2021) conclude that SMEs can take advantage of circular economy practices by integrating absorptive capacities into their operations.

Note: Created by owner.

For the table above, multiple scholars have undertaken empirical research using different theoretical lenses and perspectives to advance the discourse on circular economy and its adoption. These theories have contributed to the circular economy discourse both at micro, meso and macro levels. However, the study aims to offer insights into factors that could enable SMMEs in the manufacturing sectors to adopt circular economy practices. Thus, these factors are likely to extend beyond the organization's borders.

In this context, socio-technical systems define the organization as an amalgamation of the social and technical systems open to the environment. Therefore, the STS theory is best suited to answer the research question on the factors that could enable SMMEs in the manufacturing sector to adopt circular economy practices.

2.4.2 Drivers to Adopting Circular Economy

The increasing consumer awareness and stricter government environmental regulations have led many organizations to reconsider the value logic. According to Govindan and Bouzon (2018), stricter government environmental regulations and customers' environmental awareness are some drivers pushing the industry to consider alternative value-creation methods.

As such, organisations must innovate or adopt more innovative business models to meet customers' sustainability and societal needs. Thus, adopting a circular economy is one such proposition (Korhonen et al., 2018; Patwa et al., 2021).

Accordingly, Sajjad et al. (2020) identified customer expectations, top management commitment, managers' moral and ethical values, reputation management and economic and operational benefits as drivers for sustainable supply chain implementation.

In addition, Mehmood et al. (2021) identified environmental restoration, government intervention, and financial benefits as the main drivers in agro-food supply chains. In this context, the financial benefits are derived from operational efficiencies through waste minimization using recycled materials (Bocken & Ritala, 2022; Hu et al., 2021; Prieto-Sandoval et al., 2018; Tura et al., 2019). Therefore, minimizing the impact on the environment.

Additionally, de Jesus and Mendonça (2018) have concluded that social awareness and regulatory factors also drive the adoption of the circular economy. In this context, customers may prefer companies with an excellent social and environmental reputation, and the government can influence the organization's strategic decisions by enforcing compliance with the regulations (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018).

However, more is needed to fully align with the findings of Ranta et al. (2018), who concluded that the regulatory pillar alone could not affect the adoption of the circular economy. In this context, Ranta et al. (2018) asserted that the normative and the cognitive pillars were high and could negate the regulatory pillar's effects.

According to Mathivathanan et al. (2022), increasing population and urbanization, funding availability, and resource consumption were the three main drivers supporting SMEs' adoption of a circular economy in India. Thus, besides the availability of funding, other social factors and ecological factors drive the adoption of the circular economy.

Further, Mathivathanan et al. (2022) concluded that these three drivers affect environmental and circular economy awareness. This further drives social and ethical concerns among SMMEs, resulting in consumer demand for refurbished products. Thus, the consideration for long-term sustainability benefits preserving the environment through reduced consumption of natural resources.

Despite differences in drivers, everyone agrees to move toward a more sustainable way of producing and consuming resources. In other words, decoupling economic growth from the environment.

In conclusion, there are multiple barriers to adopting the circular economy. Extent literature suggests that government intervention, customer demands, availability of finance, ecological factors and economic benefits are some drivers that drive SMEs to adopt a Circular economy.

However, there needs to be a clear consensus regarding the role of the government institution. As asserted by Rant et al. (2018), the regulatory pillar alone is insufficient to affect the adoption of the circular economy.

2.4.3 Barriers to Adopting Circular Economy

There has been extensive research on the benefits of the circular economy within organisations (Nudurupati et al., 2022). However, adopting circular economy practices is shallow in many emerging markets because of institutional voids and sustainability paradoxes (Jabbour et al., 2020).

While other scholars blame it on technological barriers (Kirchherr et al., 2018), various scholars have investigated drivers and barriers to adopting the circular economy. However, there has yet to be a consensus on how some identified barriers influence organizations adopting circular economy practices.

2.4.3.1 Institutional and Regulatory Barriers

Sharma et al. (2021) claim that government pressure is ineffective in transitioning SMEs to a circular economy. According to Nudurupati et al. (2022) and Govindan (2018), governments can positively influence the adoption of a circular economy. Therefore, suggesting multiple roles, the government can play in implementing a circular economy.

According to Govindan (2018), the government influences firms to adopt a circular economy through a regulatory framework, incentives and proper governance. On the other hand, Zuchella et al. (2019) assert that a lack of regulatory framework inhibits the transition to the circular economy, while in other instances, they favour a linear economy. At the same time, Grafström & Aasma (2021) asserted that regulatory frameworks could also contribute to market and technological barriers.

At the same time, Jabbour et al. (2020) could not confirm the role of regulatory authorities (government) in adopting a circular economy. However, as asserted by García-Quevedo et al. (2020), SMEs considering disruptive innovation to redesign products and services will consider regulatory frameworks (governmental processes and cost of compliance) before making such a decision.

According to de Jesus and Mendonça (2018), modulating the behaviours through the double policy role in that policies indirectly trigger reactions that are desired in themselves and the ability also to limit the development of the circular economy.

2.4.3.2 Organizational Barriers

Many scholars have investigated the influence of organizational factors such as leadership, skill, innovation and culture (Chowdhury et al., 2022). Organizational leadership impact the organization's culture and innovation capabilities to support SMEs' adoption of a circular economy (Chowdhury et al., 2022).

Thus, it asserts that the weakness of management visions and hesitant organizational cultures (Kirchherr et al., 2018) are potential barriers to adopting a circular economy (Sharma et al., 2021). Management's commitment drives all these to align circular economy strategies with organizational objectives. As asserted by Sharma et al. (2021), management commitment is a significant barrier to adopting the circular economy.

In addition to its role in the creation of CE culture in the organization (Centobelli et al., 2020), top managers' commitment contributes to eradicating organizational hurdles for the implementation of green initiatives (Kitsis & Chen, 2021) and mediating the efficiency of interconnections of all actors along the supply chain (Centobelli et al., 2020).

Therefore top management commitment is significant for augmenting a disposition that enables value co-creation and co-capture process (Centobelli et al., 2020). With top management commitment, formulating an appropriate strategic orientation and advancing sustainable initiatives becomes realistic (Kitsis & Chen, 2021).

Yamoah et al. (2022) contend that top management commitment and disposition to participate in circular economy conversations can support or hamper strategies for implementing a circular economy. While Sohal & De Vass (2022) concluded that leadership passion and vision to embrace CE rather than focusing on economic gains leads to a successful transition to CE.

Top echelons theory posits that top managers in organizations affect organizational influence through a tiered (top-down) process and possess a pivotal role in determining organizational culture and climate (Arieli et al., 2020). Like other employees, top managers strive to conduct themselves with their values (Arieli et al., 2020).

Therefore, the value inclinations of top managers are likely to inform their strategic choices and thus impact the organization (Arieli et al., 2020), denoting the need for the individual top manager-organization value congruency for top management commitment

in outlining business strategies choices and actions for adopting green initiatives (Kitsis & Chen, 2021)

Yamoah et al. (2022) contend that top management's commitment and disposition to participate in CE conversations can support or hamper strategies for implementing CE. In addition, to individual top managers' values and convictions, top management commitment can shape the organization's responsiveness or inaction towards the promotion of CBM (Yamoah et al., 2022).

2.4.3.3 Knowledge and skills Barriers

Organizations need the required skills and expertise to overcome the hurdles of adopting and implementing a circular economy (García-Quevedo et al., 2020; Nudurupati et al., 2022; Sharma et al., 2022) and experience (Sharma et al., 2022).

According to Hopkins et al. (2018), circular economic setups are dynamic and subject to commercial pressures and regulatory changes. Consequently, faster innovation cycles and re-alignment capabilities are necessary to manage the transition (Hopkins et al., 2018).

Therefore, managers must balance linear and circular systems and respond to fast technological changes and market volatility (Hopkins et al., 2018). Thus, training employees to acquire relevant skills and innovation capability is a prerequisite to adopting a circular economy (Sharma et al., 2022).

Further, the dominant interventions propelled in the industry focus on recycling, reuse and repair (Kirchherr et al., 2017; Korhonen et al., 2018; Murray et al., 2017). Accordingly, these are accessible interventions to minimize waste (Katz-Gerro & López Sintas, 2019). Therefore, putting a significant emphasis on reducing the consumption of natural resources to limit environmental impacts (Rosa et al., 2019).

2.4.3.4 Cultural Barriers

Consumer preferences and behaviour remains significant for organizations adopting a circular economy (Patwa et al., 2021; Sharma et al., 2021). Because of a lack of consumer interest and awareness leads to the non-acceptability of remanufactured products and the use of products as services by consumers (Patwa et al., 2021; Sharma et al., 2021).

According to Sharma et al. (2021), recycling attracts few consumers. However, there is uncertainty among consumers about recycled goods due to quality concerns and a need for more awareness among consumers of recycled goods (Sharma et al., 2021).
Further, consumers must contend with counterfeiting and product authenticity risks (Jain et al., 2022), product aesthetics, and greenwashing concerns (Rausch & Kopplin, 2021). Hence, it drives the market factors that create inertia for SMEs to adopt a circular economy (Kirchherr et al., 2018).

De Jesus and Mendonça (2018) assert that cultural barriers are driven by sensitivity to social and environmental problems and business perception to prevent reputational risk. To overcome this hurdle, consumers should be willing to change their attitude towards green products and environmental concerns (Jaiswal & Kant, 2018).

Consumers' purchasing intention shifted from new to second-hand and remanufactured products as a result of the environmental and social benefits of the circular economy (Dhir et al., 2021; Kumar et al., 2021).

Accordingly, Sohal et al. (2022) contended that collaboration with consumers as they are part circular economy value chain. Thus, products and services must be co-created with the end users in the value chain while taking care of their needs (de Jesus & Mendonça, 2018).

2.4.3.5 Economic Barriers

It has been argued that adopting the circular economy has been hindered by a lack of understanding of the basics, such as implementing circular economy initiatives and circular business models (Malik et al., 2022).
In considering the scope of the circular economy, García-Quevedo et al. (2020) concluded that being involved in more than one of the circular economy activities will change the firm’s perception of financial obstacles.

According to García-Quevedo et al. (2020), the ability of the firm to reconfigure its operations and exploit opportunities is linked to its resources and capabilities. As such, Kirchherr et al. (2018) asserted that circular economy initiatives are expensive (Kirchherr et al., 2018). Therefore, making the cost of implementing is a critical barrier to the adoption of a circular economy (Gedam et al., 2021).

Although, in some cases, technical solutions are already there; however, due to high initial capital outlay and market uncertainty, such solutions lack practical applications (de Jesus & Mendonça, 2018). Thus, a lack of financial support leads to SMEs not adopting such business models (Malik et al., 2022).

Garca-Quevedo et al. (2020) emphasize that a lack of funding is one of the most significant obstacles to engaging in circular economy activities. Thus further creating organizational inertia towards adopting circular economy practices.

Sharma et al. (2018) assert that SMEs do not have the means to finance the initial investment cost required for developing and implementing circular economy initiatives. Thus, difficult for SMEs to adopt a circular economy as they need to overcome the non-availability of internal funds combined with the borrowing costs (García-Quevedo et al., 2020).

Therefore, calling for reform in the financial system to unlock investment opportunities (Sharma et al., 2021) and government financial subsidies to minimize the high upfront investment costs (Kirchherr et al., 2018).

2.4.3.6 Recycling barriers

Recycling is the process of reclaiming materials, products, or substances from post-consumer and post-producer waste, whether for the original purpose or for another (Malik et al., 2022; Ranta et al., 2018). Thus, the manufacturing and waste management industry is core to the circular economy (Ranta et al., 2018).
A circular economy requires firms to consider accessible, usable waste as raw materials or as sources of energy (Govindan & Hasanagic, 2018). Accordingly, waste-derived resources can be a viable alternative to virgin materials and fossil fuels (Govindan & Hasanagic, 2018). According to Govindan & Hasanagic (2018), such waste flows may be reduced when products are remanufactured, refurbished, or reused for longer periods of time.

Further, secondary plastic costs influenced by high collection, sorting and processing costs contribute to the non-availability of recycled resources (Paletta et al., 2019).

Similarly, Sharma et al. (2021) concluded that SMEs could not recycle their material due to challenges such as a lack of technical knowledge and recyclability issues.

Meanwhile, Ranta et al. (2018) highlighted that food-heavy recycled materials, particularly from emerging economies, have reduced recycling potential. Thus, creating a challenge for SMEs to access suitable recycled resources.

As asserted by Paletta et al. (2018), the volume of plastic waste is also uncertain. Additionally, the inability to manage irregular and significant volumes of waste is causing high costs and a vulnerability to the market.

Thus, creating competition between virgin and recycled materials. Thus, to fill the volume gaps, firms in question are likely to resort to the use of virgin materials, thus creating an undesirable dependency path from the sustainability viewpoint (Govindan & Hasanagic, 2018).

Moreover, recycling is driven by both formal and informal sectors; thus, possible inconsistencies in the collected waste materials. Thus influencing the quality of recycled materials. The case study by Paletta et al. (2018) for SMEs in Italy found that quality issues were the primary concern about the limited use of recycled materials. Some impurities may cause problems with the processing parameters (Paletta et al., 2018).

All these factors support the view by Sharma et al. (2021) that SMEs are incapable of handling remanufacturing of the used products due to insufficient resources and the cost of rearranging their operations. In addition, as Kirchherr et al. (2018) asserted, low prices of virgin materials will create an insurmountable challenge for circular economy products to outpace their linear economy counterparts. Thus, creating barriers for SMEs from adopting the circular economy.

2.4.4 Factors Enabling the Adoption of circular economy

2.4.4.1 Leadership and Top Management Commitment

Literature suggests that commitment by top managers is essential for distinguishing the genuineness of the adopted sustainability strategies. Without top management commitment, implementing such strategies will likely be unsuccessful (Wijethilake & Lama, 2019).

Thus, top management's resource allocation and deployment decisions are essential to effect change and successfully implement circular economy initiatives (Govindan & Hasanagic, 2018; Moktadir et al., 2020; Wijethilake & Lama, 2019). Therefore, enabling SMMEs to implement a circular economy at an operational level (Sarja et al., 2021).

According to Kitsis and Chen (2021), top managers' commitment contributes to resolving organizational inertia, creating a culture that supports adopting circular economy practices. Thus the role of top management is to create unified strategies and visions that foster employee commitment (Betrasini et al., 2021). This supports the findings that strong leadership or leadership vision is key to a successful transition to a circular economy (Sohal & De Vass, 2022).

Accordingly, top management commitment is significant for augmenting a disposition that enables value co-creation and co-capture process (Centobelli et al., 2020). Moreover, with top management commitment, formulating an appropriate strategic orientation and advancing sustainable initiatives becomes realistic (Kitsis & Chen, 2021).

For the successful implementation of circular economy interventions, the top management should provide the necessary mandates for the circular economy (Veleva & Bodkin, 2018). However, top managers' willingness to trust in the transformation is essential to drive organizational adaptation to circular business models (Centobelli et al., 2020).

2.4.4.2 Stakeholder collaboration

According to Yamoah et al. (2022), a key ingredient to promoting stakeholder engagement in the circular economy is alignment between executives' values and beliefs and the organization's circular economy values and objectives.

On the other hand, extant literature has highlighted the role of multiple stakeholder collaboration (Sohal & De Vass, 2022; Sohal et al., 2022), in particular the role of government in providing financial and technical support (Alonso-Almeida et al., 2021) to support the adoption and implementation of CE within SMEs.

As identified in the section above, multiple barriers inhibit SMEs from adopting a circular economy. A study conducted by Journaleault et al. (2021) concluded that stakeholders play a diversity of complementary roles when supporting sustainability practices within SMEs, including "training, analyst, coordinator, specialist, and financial provider" (p. 30).In this context, supporting SMMEs to fill the capability gaps inhibits their transition to a circular economy (Aarikka-Stenroos et al., 2022).

Further, Jabbour et al. (2020) assert that stakeholders can influence how SMEs engage with barriers and motivators to a circular economy. This demonstrates one way the government can facilitate the creation of stakeholder networks capable of enhancing the adoption of a circular economy (Journeault et al., 2021).

2.4.4.3 Government support

Hopkinson et al. (2018) assert that economic growth and transition to sustainability practices require business-government collaboration to ensure key policies and address key system barriers. As an institution, the government has multiple roles in motivating SMEs to adopt a circular economy.

Virmani et al. (2022) state that the government can support SMEs through varying implementation schemes and plans. Beyond developing new legislation and directives, the government can reform their tax systems to focus on circular economy models. Therefore, incentivizing enterprises to adopt a circular economy (Malik et al., 2022).

As highlighted by Vimani et al. (2022), tax reductions and tax benefits have been found to motivate SMEs to adopt the circular economy. Moreover, the government can catalyze the circular economy by providing necessary grants to fund research and development (Mokatdir et al., 2020) and implementing preferential procurement programs (Hofmann,2019).

Secondly, the government has a role in creating general awareness about the circular economy benefits and the associated risks of not adopting a circular economy at societal and industrial levels (Malik et al., 2022).

According to Govindan and Hasanagic (2018), the government significantly impacts adopting a circular economy within the supply chain. However, this will require cohesion

in current government thinking and synergy between various government departments (van Keulen & Kirchherr, 2020).

2.4.4.4 Availability of Circular Economy Funding

The evolution of the circular economy market creates unique financial risks to its business models that challenge traditional financing instruments (Austin & Rahman, 2022). Thus, most funding providers are hesitant to invest in such circular economy initiatives due to the associated risks in the business models.

This lack of funding further inhibits SMEs from adopting a Circular economy. Thus, enabling SMEs to adopt a circular economy will require alternative sources of funding (Ghisetti & Montresor, 2020; Jinru et al., 2022).

In this context, it is crucial to find SMEs to adopt circular economy initiatives considering their difficulties in accessing private funding (Austin & Rahman, 2022). Moktadir et al. (2018) concluded that funding availability promotes the adoption of the circular economy.

Mathivathanan et al. (2022) also concluded that circular economy awareness and technological advancement are directly influenced by the availability of funds. Therefore, businesses must adopt resource-efficient product design and manufacturing to provide resilience and competitive advantage (Mathivanathanan et al., 2022).
Although traditional funding still matters for advancing a circular economy, alternative funding sources such as self-funding, debt funding, and public funding significantly impact SMEs adopting specific circular business models (Ghisetti & Montresor, 2020).

Further, Moktadir et al. (2020) found that government funding is a crucial success factor in facilitating the redesign of supply chain networks in support of circular economy implementation. On the other hand, Jinru et al. (2022), green financing and logistics significantly impact sustainable production and circular economy.

Therefore, consideration must be included in the financing strategies for green manufacturing and sustainable goods to advance the circular economy (Jinru et al., 2022).

2.4.4.5 Competencies and Access to Capabilities (Expertise)

According to Sharma et al. (2021), adopting the circular economy has multiple barriers and impediments that inhibit its practical adoption. Thus, facilitating the transition to the circular economy would require SMEs to build the necessary competencies and access the relevant capabilities (expertise).

This will require SMEs to re-evaluate their core, acquire relevant competencies and capabilities, and adopt the circular economy (Kuhlmann et al., 2022). Thus, SMEs must develop these competencies by training their employees (Sharma et al., 2021) and learning and exchanging knowledge with them (Prieto-Sandoval et al., 2019).

Highlighted by Kuhlmann et al. (2022), circular economy innovation and adoption have a broader implication on the value chain; as such, they go beyond the individual company's border. Thus, SMEs must consider external sources of knowledge and information to facilitate the circular economy adoption process (Prieto-Sandoval et al., 2019).

Therefore, the SME must collaborate with the relevant stakeholders such as academia, the private sector, public institutions, research centres and design schools to build such competencies and capabilities (Massaro et al., 2020; Prieto-Sandoval et al., 2019; Sohal et al., 2022; Zhang et al., 2020). Ferronato et al. (2019) concluded that external support led to the adoption and implementation of the circular economy in the developing regions of the European Union.

Journeault et al. (2021) highlight that these collaborations play a complementary role in supporting SMEs in addressing challenges inhibiting SMEs from adopting the circular economy.

2.5 Conclusions

The purpose of this chapter was to provide a conceptual definition of the circular economy, its evolution and limitations. As a conceptual concept, the circular economy is based on no economic model or philosophical theory (Friant et al., 2020) and has multiple non-converging definitions, barriers (Homrich et al., 2018) and limitations (Friant et al., 2020; Korhonen et al., 2018).

To transition to a circular economy, organisations need to adopt circular business model propositions throughout the value chain (Centobelli et al., 2020; Manninen et al., 2018). Thus, upending their existing business models. It remains unclear whether these business models can be designed and successfully implemented (Centobelli et al., 2020; Marrucci et al., 2021).

In spite of the limitations and barriers to the adoption of a circular economy, there are drivers that justify its adoption. Multiple scholars have undertaken empirical research using different theoretical lenses and perspectives to advance the discourse on the circular economy and its adoption. These theories have contributed to the circular economy discourse both at the micro, meso and macro levels.

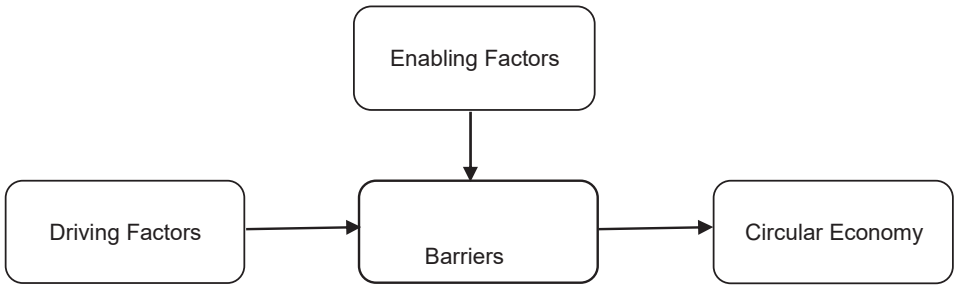
Through the literature review, the chapter highlighted seven critical barriers that inhibit organizations from adopting a circular economy as follows, (1) Institutional and regulatory barriers, (2) Technological barriers, (3) Organizational barriers, (4) Knowledge and skills barriers, (5) Cultural barriers, (6) Economic barriers and, (6) Recycling barriers. These barriers are equally applicable to SMEs within the manufacturing sectors.

Further, the chapter identified and discussed critical factors that enable the adoption of the circular economy by SMEs; these factors include the following; (1) Leadership and top management commitment, (2) Stakeholder collaboration, (3) Government support, (4) Availability of circular funding, and (5) Competencies and access to capabilities (expertise).

In this context, the chapter concludes with the conceptual model (Figure 4), which depicts the causal relationship between drivers, barriers and enablers of the circular economy. Though justifiable reasons for implementing a circular economy exist, barriers make it difficult for SMMEs to adopt and implement circular economy practices. Therefore, this study aims to investigate factors that could enable SMMEs to implement circular economy interventions and business models within the manufacturing sector in South Africa.

Figure 4

Conceptual model for the adoption of the circular economy interventions



Note: created by owner

Chapter Three: Research Questions

The research aims to identify and explain factors enabling organisations to adopt circular economic practices. In addition, to contribute to CSIR's recent analysis of the current development path of South Africa's manufacturing sector and its vulnerability to future resource scarcity.

Consequently, South Africa's manufacturing sector plays a crucial role in its economic recovery and future development. Therefore, this study aims to identify and explain factors that could enable micro, small, and medium manufacturing enterprises to adopt circular economy practices in South Africa.

Extant literature suggests that transitioning tocircularr economy is a complex process (Patwa et al., 2021; Vermunt et al., 2019) that involves organizations adapting their value creation processes (Lüdeke-Freund et al., 2018). While considering environmental and social sustainability (Centobelli et al., 2020).

Despite the circular economy's potential benefits, its adoption remains moderate (García-Quevedo et al., 2020). In light of this, limited research has been conducted on frameworks that help small and medium-sized enterprises adopt the circular economy (Marrucci et al., 2021). As a result, the principal research question can be formulated.

> **Principal Research Question**: What are the main factors enabling small, medium and micro enterprises to adopt the circular economy?

Several studies have identified multiple factors enabling organisations to implement a circular economy (Journeault et al., 2021; Mathivathanan et al., 2022; Sohal & De Vass, 2022; Sohal et al., 2022; Virmani et al., 2020; Witjethilake & Lama, 2019).

Nevertheless, circular economy innovation and adoption affect the entire value chain, so they transcend beyond the borders of an individual company (Kuhlmann et al., 2022). Thus, SMEs must consider external sources of knowledge and information to facilitate the circular economy adoption and implementation process (Prieto-Sandoval et al., 2019).

SMMEs are willing to adopt circular economy practices, according to (Sohal et al.,2022). However, barriers to implementing circular economy practices vary from country to country (Patwa et al., 2021). Therefore, barriers to adopting a circular economy compel SMMEs to partially implement circular economy practices in favour of profits (Dey et al., 2020; Ormazabal et al., 2018; Sohal et al., 2022).

Therefore, there is a need to investigate further the potential barriers preventing SMMEs from adopting circular economy interventions. As a result, the following research questions must be addressed:

> **Research Sub-Question 1:** What factors could inhibit small, micro and medium enterprises within the South African manufacturing sector from adopting circular economy interventions?

The current concept of circular economy is unclear (Bantacourt & Zartha Sossa, 2020) and has multiple limitations (Korhonen et al., 2018) and barriers that impede its practical application (Sharma et al., 2021). Hence, several scholars have investigated barriers to implementing circular economy interventions in different geographical areas with varying outcomes (Kirchherr et al., 2018).

According to Journeault et al. (2021), some barriers include a lack of awareness of the concept, resource constraints and a lack of competence and capabilities. At the same time, some of the limitations include the physical limits to recycling and recovery, intra- and inter-organisational limits (Korhonen et al., 2018) and lack of tools to assess the circularity and longevity of products and services (Figge et al., 2018). As such, SMMEs must consider all these barriers and limitations before adopting circular economy interventions.

Further, Malik et al. (2022) asserted that the main criticism of circular economy adoption is a lack of basic understanding of implementing circular economy initiatives and the possible financial outcomes. As Hopkins et al. (2018) noted, circular economy operations are dynamic and subject to commercial and regulatory changes.

Consequently, this lack of clarity and uncertain financial outcomes create organisational inertia towards implementing a circular economy (Kirchherr et al., 2018). Hence, low adoption of circular economy interventions. Therefore, for SMMEs to implement circular

economy interventions, it is necessary to understand what factors would make this possible.

> **Research Sub-Question 2:** What factors could enable small, micro and medium enterprises within the South African manufacturing sector to implement circular economy interventions?

Transitioning to a circular economy requires adaptation to value-creation processes, consumption and disposal of products (Centobelli et al., 2020). According to Schroeder et al. (2019), some circular economy interventions present product and process complexities and require extensive stakeholder collaboration.

Therefore, the organisation must introduce new technologies and cause disruptions in its existing operations. In this context, successfully implementing circular economy interventions would require organisations to re-evaluate their competencies and capabilities (Kuhlmann et al., 2022) and create organisational cultures that foster innovation and employees' commitment (Betrasini et al., 2021).

However, some of these competencies and capabilities usually need to be developed within the organisation (Kuhlmann et al., 2022). Therefore. SMMEs to get such competencies and capabilities outside the boundary borders of their organisations. In this context, extant literature needs to address the complexities associated with implementing circular economy interventions and business models (Centobelli et al., 2020), while Betancourt Morales and Zartha Sossa (2020) argue that circular economy adoption frameworks are incomprehensible.

Further, there needs to be more research on how SMMEs implement circular economy interventions (Marruci et al., 2021). According to Dey et al. (2020), most research has primarily focused on implementing a circular economy in large organisations (corporate). Consequently, SMMEs need help assimilating circular economy interventions into their organisations (Marrucci et al., 2021).

The question then arises as to what factors could enable SMMEs to adopt circular business models.

Research Sub-Question 3: What factors could enable small, micro and medium enterprises within the South African manufacturing sector to implement circular business models?

With the potential of a circular economy to drive sustainability (Manninen et al., 2018), scholars and practitioners have recognised that circular business models can function as a lever for solving environmental and socio-economic challenges (Hofmann & Jaeger-Erben, 2020).

Despite existing research on the benefits of the circular economy within the organisation (Nudurupati et al., 2022), adopting circular economy practices is shallow in many emerging markets with institutional voids and sustainability paradoxes (Jabbour et al., 2020). In this context, Fehrer and Wieland (2021) asserted that the lack of adoption of circular business models is attributed to the extant literature on circular business models.

According to Centobelli et al. (2020), literature on circular business models needs to elucidate how organisations should design and assimilate these models into their value chains. Hence, low adoption of circular business models. According to Schroeder et al. (2019), designing and assimilating circular business models is challenging.

The challenge, therefore, lies in integrating circular economy strategies into SMME business models (Marrucci et al., 2021). Further, Marrucci et al. (2021) asserted that this lack of assimilation is driven by a lack of research on the successful implementation of the circular economy focusing on SMMEs in the manufacturing sector. At the same time, Hofmann & Jaeger-Erben (2020) attributes this inertia to a need for more theoretical and practical knowledge about circular business model innovation.

Even with the correlation between circular business models and the organisational dimension of the firm, circular business innovation processes still need to be explored (Hofmann & Jaeger-Erben, 2020), scattered and fragmented (Chen et al., 2020).

Chapter Four: Research Methodology

4.1 Introduction

This cross-sectional study aimed to identify and explain factors that enable SMMEs to adopt circular economic practices. The study was based on a qualitative exploratory research paradigm and interpretivism epistemology.

Since the research question was exploratory, data was collected through interviews conducted with SMME executives, owners and senior managers within the manufacturing industry using a semi-structured interview questionnaire.

Given the narrative nature of the collected data, the study followed the thematic content analysis and deductive approach to generate broad conclusions. The study relied on structural coding processes and techniques by Saldaña (2009) and was supported by Atlas. ti 22. Supported by Braun and Clarke (2006), thematic analysis is functional and offers flexibility for qualitative research.

This chapter will discuss the research methodology design philosophy, approach, and strategies and provide the arguments and justification for the methodology used for the research. Finally, the chapter will conclude by synthesising the key discussion points.

4.2 Research Design Philosophy

The study adopted a social constructionist ontology to explore factors enabling SMMEs to adopt circular economy (CE) practices. It contends that social sciences' reality is shaped by social actors and meaning-making (Bell et al., 2019). Therefore, gaining knowledge will require discerning and interviewing participants to comprehend their worldviews (Bell et al., 2019).

This approach allows for interaction between the researcher and participants through semi-structured interviews. It allows participants to guide the researcher to the significant facets and rich interpretations of their experiences (Belotto, 2018) on the role of SMMEs in adopting circular economy practices. Thus, allowing the researcher to gain

participants' insights and perspectives and to probe further where insufficient information is provided.

In addition, this approach only requires some data to be collected for data analysis to commence (Belotto, 2018). As such, data analysis can commence once the transcription of the first interview has been completed.

This provides an opportunity for the qualitative researcher to assess if the data collected answers the research question and reflect the interview technique for bias and whether how the questions were asked was neutral (Belotto, 2018). Therefore, conducting quality assurance on the research process (Belotto, 2018).

Therefore, constructionist ontology and interpretivism epistemology were appropriate for exploring and expanding initial theories (Belotto, 2018).

4.3 Unit of Analysis and Level of Analysis

According to Bell et al. (2019), the research question should indicate what units the researcher should focus on and the sample for the proposed study. In addition, part of the business research should consider the level or the primary measurement and analysis unit (Bell et al., 2019).

Considering the proposed research question, the unit of analysis is the SME business owners. They are responsible for strategy formulation and adoption in line with their enterprise objectives. Thus, advancing circular economy culture mandates top management to design cohesive strategies that cultivate employees' commitment and assimilate circular economy objectives and stakeholders' viewpoints (Bertassini et al., 2021).

Thus, supporting the transition to and adoption of circular economy practices (Marrucci et al., 2021). Hence, their insights on how they have mediated the stakeholders' pressure and designed organisational structure and culture to enable the transition of circular economy adoption will advance the current discourse on adopting circular economy practices.

4.4 Time horizon

The study adopted a cross-sectional study. Bell et al. (2019) asserted that this involves designing research to collect data at a single point to provide a snapshot and allow for a comparison of variables. As such, the study considered a setting which included executives, owners and senior managers from SMMEs affiliated with circular economy-related organisations and those not affiliated with such organisations. Thus, offering an advantage in collecting data quickly and allowing for comparison between population groups.

4.5 Research Setting

According to Bell et al. (2019), a researcher must identify a suitable research setting for investigating the research topic and formulate and determine the administration process for the research instrument.

Given the limited research on the adoption of circular economy practices by SMMEs in emerging markets, the study focused on SMMEs in the manufacturing sector in South Africa. Although the manufacturing sector is broad, the majority of the SMMES covered by the study belonged to the following sub-sectors, (1) Chemicals (Petroleum and Plastics), (2) Metals and Machinery, (4) Electrical Equipment, and (5) others (including Industrial Chemical Manufacturing, Pharmaceutical and Jewellery Manufacturing). However, the setting considered SMMEs that are located within Gauteng Province.

The proposed setting aligns with the recently published study by the Council for Scientific and Industrial Research (CSIR) on how South African manufacturing sectors could become more competitive through circular economy practices. Similarly, other scholars have followed the same approach - Dey et al. (2020) in the empirical study of circular economy adoption by SMEs within the Midlands in the United Kingdom and Sharma et al. (2020) in the study of SMEs in India.

4.6 Sampling Method, Sampling Criteria, and Sample Size

The impetus of qualitative research is to comprehend the experience from the contributor's viewpoint and take on an exploratory, theory-building approach (Merrian, 2002). Therefore, the study used a purposive snowballing sampling strategy to identify informants best suited to answer the research question (Bell et al., 2019). Therefore, asserting that participants should have rich knowledge of the phenomenon allows for most learning from their understanding and interpretations (Frechette et al., 2020; Merrian, 2002).

Therefore, sampling primarily focused on executives, owners and senior managers with working knowledge of the circular economy, its adoption and more extended service with the enterprise. In addition, participants were required to answer questions about their circular economy experience. Therefore, rating their circular economy knowledge and indicating their current or previous involvement in the circular economy.

Further, participants were required to indicate their years of involvement in circular economy and elaborate on any involvement in circular-related projects. This approach is similar to the sampling strategy used by Anwan and Sroufe (2022) in the empirical study to discern critical elements and roadblocks of the circular economy.

In addition, further consideration was given to SMMEs who have and have not adopted circular economy initiatives in manufacturing. Thus, participants were required to indicate if their organisation is affiliated with any circular-related organisations or similar. This also required participants to provide details of such organisations in case of any such affiliations.

According to Hunt (2011), the primary focus of qualitative research is not on generalisability but on gaining insights from the participants' viewpoint (Frechette et al., 2020; Bell et al., 2019; Merrian, 2002). Therefore, qualitative research is not concerned with quantities and frequencies of events (Merrian, 2002). Therefore, the sample size should not be a limitation, as the richness and quality of data take precedence over the sample size (Frechette et al., 2020).

According to Bell et al. (2019), it is almost unattainable for a researcher to know the sample size for interviews at the outset before achieving data saturation. Therefore, greater emphasis on the data saturation point will determine the sample size. Data saturation is the point at which no new themes are observed based on the available data (Guest, Bunce, & Johnson, 2006).

Beyond the data saturation point, data will tend to repetition, not offer new insights and raise further questions (Hammarberg et al., 2016). Guest et al. (2006) determined that data saturation occurs within the first 12 interviews. However, meta-themes could be available as early as the first six interviews.

In this context, to fulfil the MPHIL-CS research project requirements, the study proposed to target at most 14 participants. However, the study covered 12 participants, with the majority at the executive level of responsibility and two senior managers. Most of the executive participants in the study were founders and business owners of these SMMEs, while the senior managers were in finance and or responsible for a section or unit of the business.

4.7 Research Instrument

According to Merrian (2002), there are three main methods for data collection for qualitative research- “interviews, observations and documents” (p. 12). First, it is essential to establish the alignment between the data collection strategy and the research question. In light of the study’s purpose and the adopted ontology (Constructionism), an interview protocol was used as a research instrument for data collection.

This approach aligns with the adopted ontology and can elicit first-hand accounts, experiences and insights from the respective participants on the factors that promote the adoption of circular economy practices by SMMEs. As such, the interview protocol provides the mechanism to obtain a first-hand account from the participants. In addition, the protocol can support the purposive snowballing sampling strategy, as the protocol does not need to be sent up front.

For standardisation of the circular economy knowledge and experience, the study adopted relevant parts of the existing research questionnaire developed by Fazluddin et

al. (2022) for the study on the implementation of circular economy practices within the South African manufacturing sector.

Accordingly, permission was obtained from CSIR to use part of the research instrument (Appendix 1). Further, the study relied on this instrument to identify the manufacturing sub-sectors. In addition, a literature review of current and existing literature on adopting circular economy practices was used to develop the survey questionnaire.

Following the proposition by Krosnick and Presser (2010), the interview protocol should have a filter question to prevent asking irrelevant questions to the respondents. As such, the interview schedule (Appendix 2) included a question on the demographics, participants' knowledge of the circular economy experience, and circular intervention strategies. These sections were assessed before asking questions that dealt with the main research question. As such, this was a filter to determine suitability based on their circular economy experience.

As parts of the research instrument were adopted from Fazluddin et al. (2022), the study took the approach that those sections of the instrument have a certain degree of reliability. The instrument had been used in a prior study.

To assess the construct and the clarity of language, newly developed questions were discussed and reviewed by an academic expert before including in the survey instruments.

However, before the commencement use of the protocol for gathering the required data for the research project, the interview schedule will be submitted to the Master's Research Ethical Committee (MREC) for review and approval.

4.8 Data Gathering Process

The study adopted semi-structured interviews as a research strategy for data gathering. This approach offers flexibility as questions do not have to be asked in chronological order and allows the researcher to ask probing questions (Rowley, 2012).

According to Bell et al. (2019), additional considerations should be given to access informants and their organisational position before choosing SMEs as the primary setting

for the study. The study initially considered using data from the Council for Scientific Research (CSIR), African Circular Economy Network, and industry associations such as Packaging SA in order to identify SMMEs within the respective sectors.

However, this approach was unsuccessful. Most participants have yet to respond to the invitations, even after multiple reminders through telephone and emails. A total of 36 invitations were sent to participants; seven declined outright, while 13 did not respond to the invitations. Though 16 participants committed to participating in the study, only 12 honoured the invitation. These 12 participants were found through personal and industry networks.

To allow for flexibility and considering the current COVID-19 pandemic, data was gathered using online semi-structured interviews through Microsoft Teams. Bell et al. (2019) noted that adding the webcam could be compared to a face-to-face interview and encourage more participants to agree to be interviewed.

Moreover, the online interview offers flexibility as last-minute schedule adjustments could be accommodated (Bell et al., 2019). However, as with any technology, some limitations and challenges may cause fluctuation in the quality of the connections (Bell et al., 2019); considerations were given to these solutions, and alternate solutions were proposed.

As such, there were connectivity issues experienced during some of the interviews, thus impacting the transcription quality. In addition, as the transcription tool on Microsoft teams relied on an artificial intelligence tool, it was observed that the tool had a limited vocabulary, could not pick up different accents, and had overlaps between the researcher and the participant.

However, as asserted by Braun and Clarke (2006), there are no guidelines on how transcriptions should be produced, but rather essential to ensure that the transcripts retain the true nature of the contents from the verbal account.

The duration of the online interviews ranged from 24 to 56 minutes per participant. The first interview was about 24 minutes, while the rest were more than 30 minutes after that. Because of the online nature of the interviews, informed consent forms were attached to the invitations to participate in the research project.

Before conducting the interviews, participants were appraised about the study, its intended purpose, and their permission to participate and transcribe the interview. Informed consent forms were also signed and returned by participants.

For those who had not signed the informed consent forms, follow-up was done to ensure that the consent forms were signed and returned (Appendix 3). In addition, participants' confidentiality and anonymity were assured. With the informed consent from the participants, the semi-structured interviews were transcribed directly from form Microsoft Teams. As such, this eliminated the need for transcription services and the use of the non-disclosure and confidentiality agreement for third-party transcribers and other third-party services.

Since participation was voluntary, no incentives were offered to participants. Moreover, participants were allowed to withdraw at any time without penalty.

4.9 Data Analysis Approach

The primary focus of qualitative research is inductive - where "theory is an outcome of the research" (pp. 23-24); the two most widely used data analysis strategies are thematic analysis and grounded theory (Bell et al., 2019). Given the narrative nature of the collected data, the study followed the thematic content analysis approach.

According to Anwan and Sroufe (2022), thematic analysis has been widely used in management and business research and allows for the study of complex settings with multiple causal factors and establishes patterns from the interview data. In support of this argument, Braun and Clarke (2006) asserted that thematic analysis is functional and offers flexibility for qualitative research beyond psychology. As a result, it can also be used in the study of business and management.

In order to generate the relevant themes for the phenomenon under research, the study followed structural coding as the first coding cycle (Saldaña, 2009). Accordingly, structural coding is suitable for analysing data collected from multiple participants and semi-structured data-gathering protocols (Saldaña, 2009), mainly anchored on the primary research question.

Thus, it supports organising an extensive corpus of data through analysis of each participant's transcript and assigning codes on words and sentence segments that convey similar meanings (Saldaña, 2009) to answer the research question.

According to Saldaña (2009), "a theme is an outcome of coding categorisation and analytical reflections, not something that is, in itself, coded" (p. 139). Therefore, thought should be given to providing a comprehensive thematic statement when labelling and analysing data rather than a short code. Thus, providing descriptions of behaviours within a culture that explains why a particular phenomenon happens (Saldaña, 2009).

Thus, some initial codes identified in the first coding cycle may become redundant or subsumed into broader categories as the data gathering, and analysis process continues. In addition, this provides an advantage in that themes emerging from the initial analysis can be assessed for validity and support the researcher in shaping the interview questions as the interview process continues.

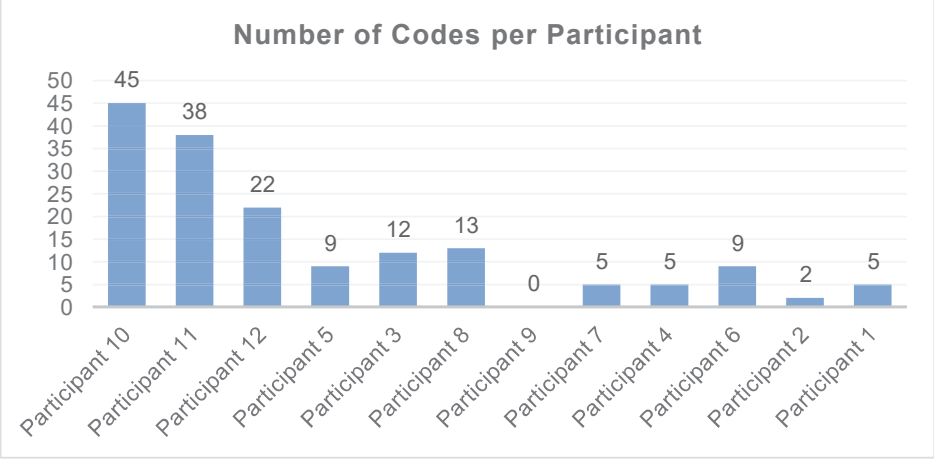
Braun and Clarke (2006) assert that thematic analysis entails searching through a data set or a wide variety of interviews to locate repeated meanings. In this context, the study used the themeing of the data using qualitative data analysis and research software - ATLAS.ti 22.

Following the deductive approach and guided by existing literature, the last three interviews were coded first, starting from interview ten, followed by interviews 11 and 12, respectively. These were considered the best interviews based on the prior interaction and engagement of the previous transcripts.

A random coding procedure was used for the remaining transcripts. The initial analysis identified a total of 165 codes (Appendix 4). However, in the second iteration, the number of codes was reduced slightly to 161. However, this did not change the saturation level. As shown in figure 4, there was no significant increase in the number of new codes generated after analysing six transcripts. Therefore, aligning with the conclusions by Guest et al. (2006), who determined that data saturation occurs within the first 12 interviews.

Figure 5

Number of codes per participant based on the initial coding

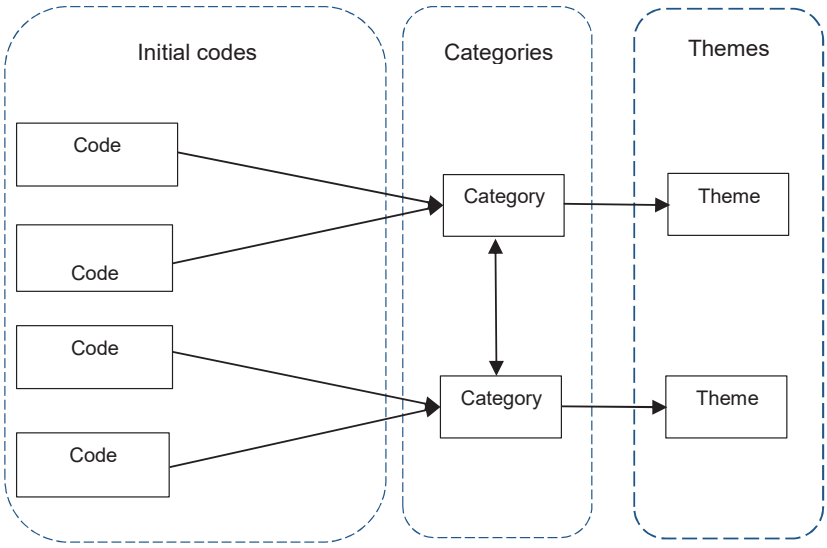


Note: Created by owner

Following the iterative approach (Braun & Clarke, 2006), initial codes were consolidated in the standard coding scheme, while others were grouped based on the exact meaning (Figure 6).

Figure 6

Conceptual coding framework

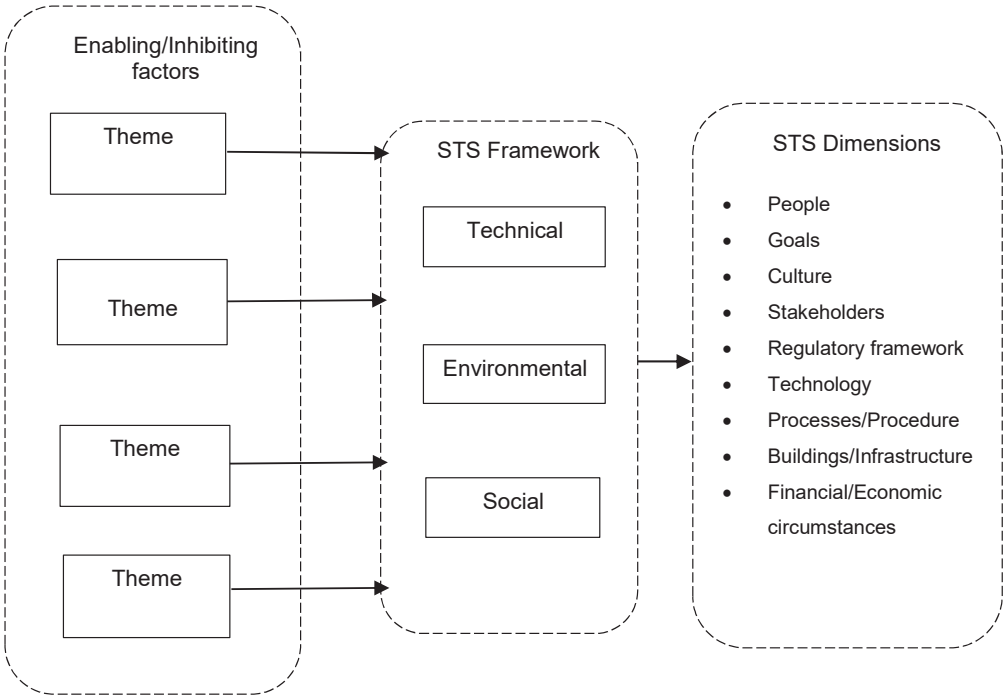


Note: Created by owner

Further, to answer the research question, the developed themes that were systematically analysed using the socio-technical framework. In this regard, it was necessary to carefully compare the themes with the literature and classify themes into the socio-technical system dimensions (Figure 7). The outcome of the analysis is detailed in chapter five.

Figure 7

Conceptual data analysis framework based on the socio-technical system.



Note: Adpated from "Capabilities of digital servitization: evidence from the socio-technical systems theory" by C. Münch, E. Marx, L. Benz, E. Hartmann, and M Matzner, 2022. *Technological Forecasting & Social Change*, 176, pp 9-10. Copyright 2021 The Authors.

4.10 Research Quality and Rigor

Bell et al. (2019) assert that "reliability and validity are criteria for establishing the quality of the business research" (p. 362). However, as the terms' validity' and 'reliability' are associated with quantitative research, they have become ambivalent within the qualitative research community (Hammarberg et al., 2016).

As the qualitative researcher is an implement for data collection and analysis, the researcher must preserve the integrity of the research through the following criteria: “trustworthiness, credibility, applicability and consistency” (Hammarberg et al., 2016, p. 499).

Due to possible researcher bias- the researcher’s influence on the research (Hammarberg et al., 2016), reflexivity and triangulation will be used to assess credibility. A researcher’s influence on a research project is stated, and data is collected from multiple sources to answer the reach question (Hammarberg et al., 2016).

Although the study proposed interviewing equal participants from SMMEs who have adopted and have not adopted circular economy practices for triangulation, the research setting and population could only identify two participating SMMEs affiliated with CE-related organisations.

Thus, triangulation was done using the data from these participants. In addition, verbatim quotes from the participants were used to show their interpretations of the phenomenon where appropriate.

Interviews were conducted with only vital participants selected through purposive sampling for validity and reliability measures. Thus allowing participants to answer questions without knowing what other participants have said or answered—a similar approach adopted by Münch et al. (2022) for construct validity.

The research used the Socio-technical systems theory, and for internal validity, coding was done once all the interviews were completed. As a result, investigator bias was minimised since the investigator did not know the research outcome.

As highlighted above, different data sources were used for triangulation from SMMEs affiliated to and Non-affiliated to CE–related organisations. Thus results could be compared and contrasted between the two groups.

For external validity, the study used SMMEs and Participants from the Manufacturing sector, with predefined criteria on the experience and knowledge of circular economy. Thus, participants had to indicate their manufacturing subsector and their level of involvement in the circular economy.

Further, to provide information on any previous involvement in circular economy initiatives. Further, participants were assessed on their knowledge and familiarity with the various circular economy interventions.

All questions were asked following the semi-structured interview protocol, and all interviews were transcribed in real-time using Microsoft Teams. In addition, coding was done once all the interviews had been completed to avoid investigator bias.

4.11 Limitations of the Research Design and Methods.

As with any research instrument, some strengths and weaknesses are likely to influence the external validity of qualitative research. As such, researcher bias is not one of the limitations of qualitative research, as the participants are selected to illuminate the phenomenon under investigation (Hammarberg et al., 2016). n

However, in considering the research setting, the study focused on SMMEs and excluded the perspective of large organisations. Within the same context, the study could only consider some SMME sectors but only be limited to the manufacturing sector.

Further, the study only covered a limited number of manufacturing sub-sectors limited to a particular geographical area. As such, this will limit the transferability of the findings to SMMEs within the chosen research setting.

4.12 Ethical Clearance

According to (Bell et al., 2019), ethical issues can happen at any stage of the research journey. In this regard, a researcher must be equipped to deal with such ethical concerns at all stages of the research process. Addressing these issues could ensure research integrity (Bell et al., 2019).

According to Wallace & Sheldon (2015), ethical issues exist in free-value research, irrespective of the methodology. Accordingly, the researcher needs to be aware of the following primary risk areas where ethical issues may arise, “the profile of justice…, the principle of merit research and integrity…and the principle of respect” (p. 275).

As such, the study followed the ethical procedures afforded by the University of Pretoria ethics committee. Consequently, ethical clearance was obtained prior to the collection of data for the study (Appendix 5).

4.13 Data Storage

According to Weller and Monroe-Gulick (2014), data practices and needs vary according to the research methodologies. For example, data produced during the search project must be securely stored and protected at all times to protect their confidentiality. Thus, the development of document storage and management protocol is part of the research methodology.

As such, data produced during the project's life cycle will be in hard copies and electronic format. Based on the findings by Monroe-Gulick (2014), most qualitative researchers store their data in hard-disk drive/CD, cloud, print and university servers. The reasons for storing and managing this data were motivated by the ease of storage and, most importantly, by privacy and security concerns. Therefore, resulting in the following data management and storage procedure:

- All hard copy confidential documents were stored in locked cupboards and a secured office,
- All electronic data, including audio/video recordings, was stored in an external hard drive and protected by a password

Thus, in compliance with the requirements of the Protection of Information Act 4 of 2018 (POPIA).

4.14 Conclusions

In conclusion, the chapter articulated and justified the chosen research methodology design philosophy, approach and strategies. Further, the chapters provided insights into the process followed for data gathering and analysis, ethical clearance, data storage, and research design and methods limitations.

Further, the chapter highlighted the importance of research quality and rigour using data from different sources for triangulation. In this context, the chapter outlined the process for comparing findings from participants from SMMEs affiliated with CE-related organisations to those not affiliated with such organisations.

An exploratory cross-sectional study was conducted based on an interpretivism epistemology. This approach is suitable for qualitative research because it provides strategies and tools to handle a large corpus of data collected through semi-structured interviews. Thus, making thematic analysis a suitable approach for data analysis to answer the research question based on the insights gathered from participants from the identified setting.

A discussion of the factors that assist SMMEs in adopting a circular economy is presented in chapter five. In contrast, the discussions and conclusions will be discussed in chapters six and seven.

Chapter Five: Research Findings

5.1 Introduction

This chapter discusses the findings based on the articulated design philosophy and the analysis of data procedures in chapter four. Finally, in response to the research question, this chapter discusses findings on demographics with a particular emphasis on the sectoral experience and the level of responsibilities of the participants.

Further, the chapter presents key findings on the circular economy experience through participants' knowledge of the circular economy and involvement in any circular economy-related projects. Finally, the chapter provides findings on SMMEs' affiliation with circular-related projects.

A presentation of factors enabling and inhibiting SMME manufacturers to implement circular economy interventions is provided, including participant familiarity with circular economy interventions.

The rest of this chapter is structured in the following manner. The first section looks at population demographics. It includes discussing the manufacturing sub-sector, enterprise size, sectoral experience, and responsibilities within respective SMMEs.

Further, the chapter covers participants' knowledge and experience of the circular economy, including participants' involvement in circular-related projects and the number of years involved. In addition, the section highlights whether the respective SMMEs are affiliated with any CE-related organisation.

As a third point, this chapter discusses factors that facilitate or inhibit the implementation of a circular economy. Thus, the chapter presents findings based on the broader themes of opportunities, drivers, and barriers/challenges and enabling factors to implement a circular economy. The chapter concludes with conclusions drawn from the findings.

5.2 Findings form Data analysis

For data analysis, the study relied on Atlas.ti.22 to analyse the transcripts. In the first iteration, the analysis generated 165 codes. These codes included demographics/profile,

circular economy experience and three research questions. In the second iteration, there were a few codes that were eliminated. This reduced the total number of codes to 137 (Appendix 4). During this process, codes that had similar meanings were merged, while other codes were grouped into identical code categories.

Codes assigned to categories included predefined codes, such as level of responsibility, manufacturing subsector, sectoral experience and others. Further analysis was done on the reaming codes based on the research questions. Based on this analysis, the study generated 37 themes. Each centred on three research questions.

This exercise was conducted for each research question using the STS framework in chapter 4. These themes were then further analysed into social, technical, and environmental factors. Based on the characteristics of the themes, these were further categorised into various dimensions within the STS framework. Topics outside an organisation's boundaries were classified under the stakeholder, regulatory, or economic dimensions. Similarly, these exercises were also completed for social and technical systems.

5.3. Demographics

5.3.1. Manufacturing Subsector and Enterprise Size.

Participants were required to provide information regarding the manufacturing sub-sector to which their organisation belongs to determine the characteristics of the sampled population. In addition to the sector, enterprises are categorised by size.

The setting included participants from SMMEs in the Chemical (Petroleum and Plastics), Metals and Machinery, Electrical Machinery and Equipment Manufacturing and other manufacturing subsectors (Appendix 6). The other sub-sectors included manufacturing subsectors such as Pharmaceuticals, Jewellery, and Industrial Chemicals.

Further, it was noted that one of the participants from the population was from the SMMEs that represented Electrical Equipment and Machinery and Metals and Machinery manufacturing sub-sectors.

Further, most enterprises were classified as medium enterprises, followed by micro-enterprises (Appendix 5). Based on the number of employees, SMMEs were identified as small to medium and medium to large. For example, one of the participants described the organisation as,

> "OK, we between small and medium, we have a turnover of about 50 to 60 million Rand a year. So in some categories, we in small and in some categories, we are medium" (Executive – General Manager).

While the other participant elaborated that their organisation is medium to large, based on the number of employees and turnover.

> "We to turn over more than 50 million, and we [are] more than 100 people" (Senior Manager 2)

Thus, suggesting a variation in the classification of the enterprises amongst participants.

5.3.2. Sectoral Experience and Level of Responsibility

This section presents findings of the sectoral experience of the participants within their current organisations and their level of responsibility. Thus, participants were required to indicate the number of years of experience in their current organisations.

Although the sectoral experience varied from less than one year to more than ten years, most participants have more than ten years of sectoral experience (Appendix 7). This was followed by an equal split between participants with sectoral experience between three to four years and five to ten years. The exception is one participant who has less than one-year of sectoral expertise.

For example, participants described their sectoral experience in the following manner,

> "[I] t's less than one, about a year old in October." (Executive-Owner 8)

> "[M]ore than ten years; I'm having close to 23 years, 24 years." (Executive–Owner 6)

Therefore, it highlights the wide-ranging sectoral experience of participants.

Further, survey findings indicate that most of the participants in the study were executives who identified as business owners, while other participants were senior managers (Appendix 7). For example, one of the executives described their level of responsibility as follows;

> "So the company that I run, I'm a 100% shareholder, and the Managing director of the business…" (Executive - Owner 1)

While others have described their level of responsibility as follows;

> "To be honest, it's a bit of both, but the executive level, I would say, but obviously from microenterprise and finance, because it's being a small enterprise, you got to be a jack [of] all trades." (Executive - Owner 1).

Thus, they are involved in finance and daily operations. To describe the level of responsibilities, participants provided descriptions like,

> "Well, I do all the finances, all the production, all the maintenance. I'm running the whole organisation. So I'm in charge of the organisation." (Executive- General Manager),

> "…but for the past five years now, we've been running a business in … where we manufacture HDPE pipes as well as other product types, medical devices, masks, etcetera" (Executive – Management)

The exception was two senior managers; however, they had business responsibilities. For example, one participant described their responsibilities as,

> "…, the ability to then go and be with the senior management of the mines to be able to communicate with them, have meetings with them. Senior management at also … being in directing, you know, in directing the way for the company in my area, so also being able to advise the senior management and the executives." (Senior Manager 1).

Thus, this suggests a high level of responsibility within the respective organisations.

5.4. Circular Economy Experience

Participants were assessed against the broad circular economy definition to determine their knowledge and understanding of the circular economy. This definition included three broad principles, (i) Designing out waste and pollution, (ii) keeping materials and products in use, and (iii) regenerating natural systems. Once participants were provided with this definition, they were required to rate their knowledge of the circular economy.

Further, participants were required to indicate whether they have had any previous or current involvement in circular economy-related projects and provide the number of years of involvement in the circular economy projects. This included brief explanations by participants on such projects and indicating whether their organisations are affiliated with any circular economy-related organisations. The findings of the survey are presented in the sections below.

5.4.1. Circular economy Knowledge and Involvement

The findings show that most participants have a good knowledge of the circular economy (Figure 8). However, though some participants are novices, while others have working and excellent knowledge, they have yet to respond that they do not have any circular economy knowledge.

Further, to assess the participants' circular knowledge experience, participants were required to indicate their involvement in any circular-related projects in their current or previous organization. Though most of the participants confirmed their involvement in circular economy initiatives, two participants initially gave a negative response.

However, one participant indicated involvement in the CE-related project while introducing the operations within their organization as follows;

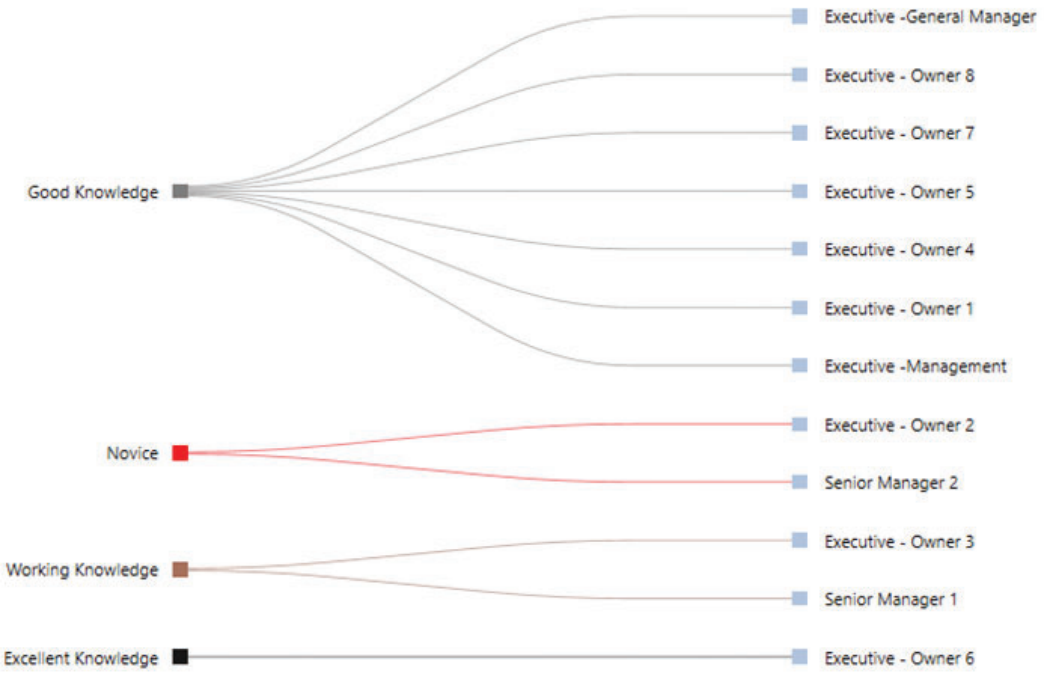
> "So our company is jobbing foundry… We make part of machineries [sic] or parts of valves… so we melt scrap metal and make it into something else." (Senior Manager 2)

Therefore, the foundry operations involved melting scrap materials and casting the molten metal into semi-finished parts for use in valves and pumps. Further, the senior manager described the foundry operations related to the core and moulding sand;

> "So with regards to the reclaiming of sand… So we use 80% reclaim [sic] sand and about 20% of new sand…. We are not dumping rubbish sand, which means it's better for the environment." (Senior Manager 2)

Figure 8

Diagram depicting circular economy knowledge of the participants and there level of responsibility



Note: Created by owner using Atlas.ti.22 software.

On the other hand, the second participant described the initiative implemented, which incentives customers with rebates for their next purchase when returning product containers;

> "… depending on the state of containers, what we've got to do to get them back into the reusable thing, whether we need to get people to dispose of them, we would adjust that depending on that sort of thing. So if we delivered and our driver

> was there, we would take photos of any return containers." (Executive - Owner 2)

Thus, indicating a level of involvement in circular economy interventions. However, as one of the participants noted,

> “I think we just have not formalised it…; I think the circular economy is the theory and the name behind it. But you know, we do practice that …as soon as a product is deemed more dangerous …, you look for a more environmentally friendly alternative." (Executive - Owner 2)

Hence, the industry must have a common understanding of the circular economy concept.

However, when probed further, these participants changed their initial negative responses and confirmed their involvement in CE-related Initiatives. Further, they have also indicated the number of years involved in such or other CE-related initiatives. As one of the executives of the industrial chemical manufacturing company explained, the circular economy is viewed differently from the perspective of the SMMEs compared to large corporations;

> "You know, I think the difference is that in a macro enterprise [sic], we do not deem it as a project. It becomes an everyday activity. … I think that is the difference as a company grows larger is that you know, you have got to strategise whereas you know when it’s a small enterprise where you can make quick decisions and implement something quickly, you don’t actually strategise and do a whole project, you do the natural things that are good for the environment." (Executive - Owner 2)

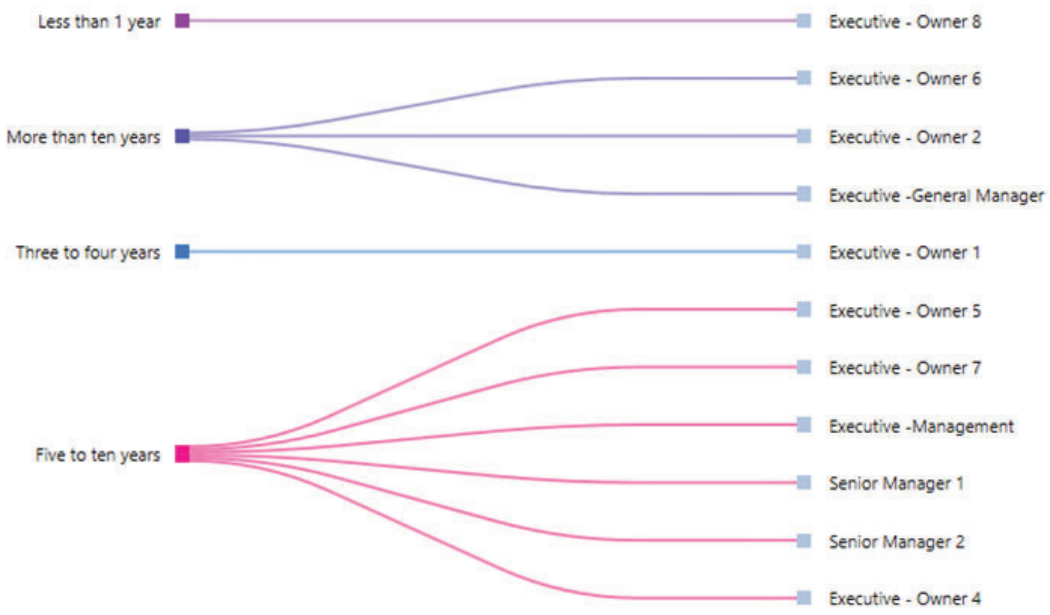
It further supports the notion that there is a lack of shared understanding of the circular economy concept.

5.4.2. Participation in circular economy-related projects

Further, participants were required to indicate the number of years of experience with circular economy-related projects. Participants had five to ten years of experience in circular economy projects (Figure 9). However, there were other participants with more than ten years of involvement in the circular economy project, particularly those from SMMEs affiliated with CE-related organizations. Unfortunately, the number of years for one participant could not be captured due to poor audio quality.

Figure 9

Illustration of the number years circular economy experience participants in the study



Note: Created by owner using Atlas.ti.22 software."

Participants were required to elaborate on some of the previous or recent circular economy initiatives to gain deeper insights into the level of CE involvement. Based on these accounts, most participants from both groups have been involved in Materials Looping, followed by Refurbishment and Circular design and Manufacturing circular economy interventions (Figure 10).

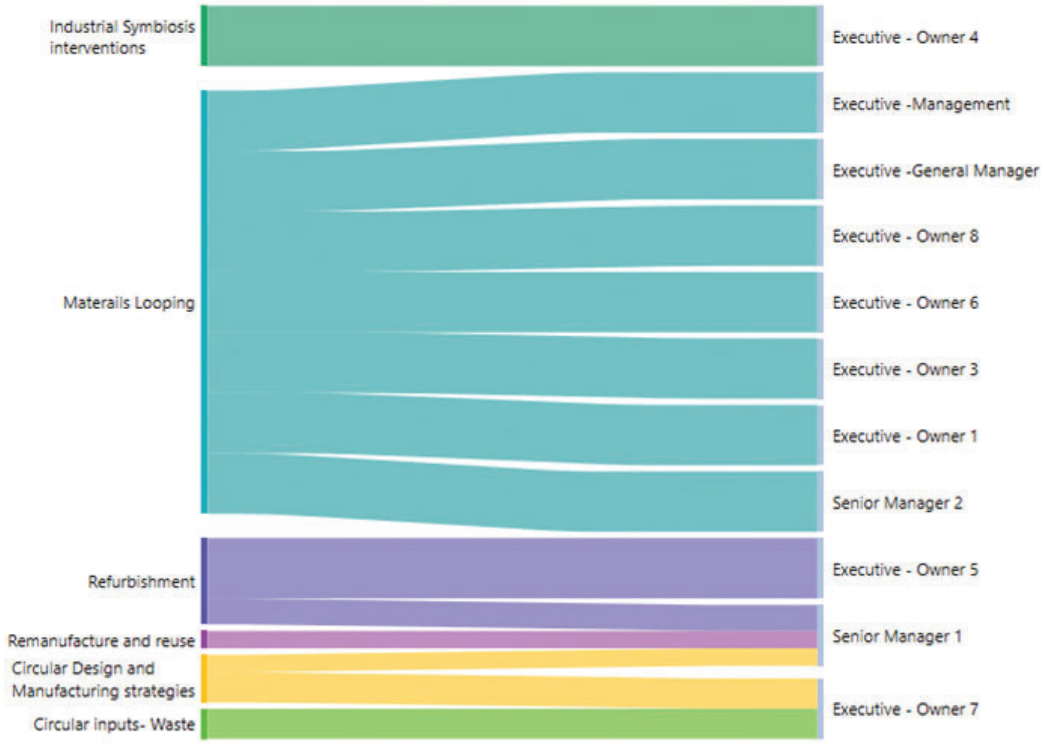
Meanwhile, other participants have previous involvement with Industrial symbiosis,

Remanufacture and reuse, and circular inputs. For example, one participant gave the following account;

> "... what we've done NCPC [National Cleaner Production Center] form part of the symbiosis project where we trying to get people who have got waste put together in one place and people who need some waste will try to help to get synergy where people would know if they have got a certain waste." (Executive – Owner 4)

Figure 10

Examples of circular economy initiatives for participants in the study.



Note: Created by owner using Atlas.ti.22 software."

Pharmaceutical enterprise owner describes how agricultural waste (Stramonium) is used to manufacture active ingredients (Scopolamine) for antidepressants. Furthermore, process by-products for bio-fuels and compost. For example,

> "[W]e get it from again invasive species… which grows well in South Africa in the maize, sunflower and soya farms." (Executive – Owner 7)

Further, the participant explained,

> "So through our studies, we found that after processing that plant material… [It] contains a bit of biogas. So you can further process for biofuel. [..] We can make compost ..., but the main part is that it can be useful, but biofuel." (Executive – Owner 7)

Another participant articulated,

> "We don't just throw out the components and replace them with new ones all the time. They are components that are reusable all the time." (Senior Manager 1)

Meanwhile, another participant explained the longevity that can be obtained through refurbishment and also highlighted the cost-saving benefits of refurbishment,

> "But they keep on paying 100% and throw away those that are damaged or something is wrong with it. You'll find that if you know well, you have seen a valve. It's just a wheel attending wheel that is broken… But you can take that wheel and just change [a] few things. Put some seals that valve can make another five years." (Executive – Owner 7)

The findings show a broad experience and involvement in circular economy-related projects.

5.3.3. Affiliations with Circular Economy-Related Organizations

As part of the analysis of SMMEs affiliated with circular-related organizations, participants were required to indicate affiliations to such organizations. Depending on the response, they were further required to elaborate on the details of such affiliation. The survey findings show that most SMMEs were not affiliated with any circular-related organizations (Figure 11).

However, two SMMEs were affiliated with circular-related organizations: the South African Recycling Organisation, South African Plastic Pact and the Alliance to End

Plastic Waste. Two participants affiliated with circular economy-related organizations gave the following details;

> "Yeah, so the SA Plastic Pact, indeed. We are registered with them, and the other one global one is called the Alliance to End Plastic Waste." (Executive – Owner 1)

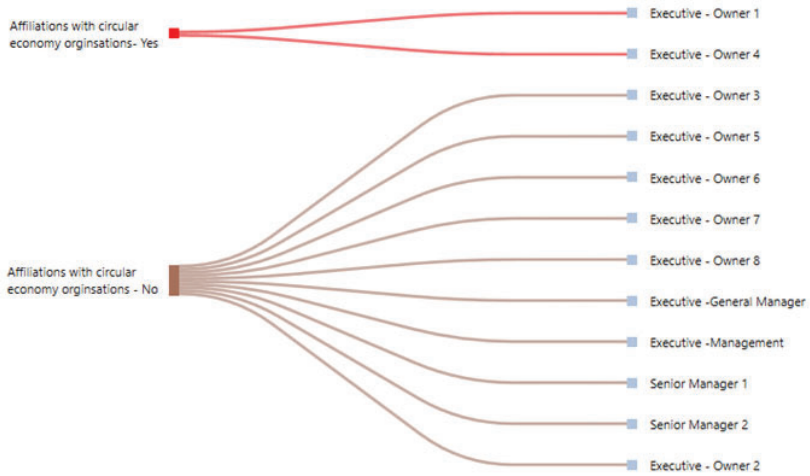
> "So just went to be affiliated with South African Plastic Recycling Organizations." (Executive – Owner 4)

Meanwhile, one of the participants from SMMEs not affiliated with any circular economy-related organizations explained that they would like to join such organizations to gain knowledge,

> "No, not yet. I would love to know how I can be a part of them so I can learn more. I just joined someone [on] Facebook so I can learn more from others so I can get to improve that." (Executive – Owner 8)

Figure 11

Illustration of the number of SMMEs affiliated and not affiliated with circular economy related organisations



Note: Created by owner using Atlas.ti.22 software."

While the other participant indicated that their director has excellent knowledge,

> “No, I don’t think our company [is] involved with any circular, but I do know that our director has a very good knowledge of circular economy.” (Senior Manager 1)

5.5. Familiarity with Circular Economy Interventions

Before assessing factors enabling SMMEs within the manufacturing sector to implement a circular economy, participants were surveyed on the knowledge of circular economy interventions. Participants were presented with thirteen different circular economy interventions from the literature. They were required to indicate whether they were unfamiliar, partly familiar, familiar, or very familiar with the respective intervention strategies.

The findings indicate that materials looping (Recycle, Reuse and Repair) are the most predominant circular economy intervention in the manufacturing sectors (Appendix 8). Further, the finding aligns with the manufacturing subsectors that the study considered. Circular business models are another circular economy intervention introduced to the participants in this same context, but only a few are aware of it. As such, circular business models had a lower prevalence amongst the participant in the category of circular economy interventions participants were very familiar with

Conversely, most participants needed to familiarise themselves with circular interventions such as Green steel manufacturing and Circular textile design. As a result, the prevalence of these two interventions was very high within the "unfamiliar" category of circular economy interventions.

Overall, the findings suggest a significant variation within the manufacturing industry concerning different circular economy interventions. That said, there is a strong indication that Materials looping is the primary circular intervention practised in the manufacturing sector. For example, participants provided the following accounts in providing the descriptions of their operations;

> "So, the business that I started… I have two people who help me… collect plastics that are thrown away, plastic bottles and plastic tubs and lollipop sticks. And I create jewellery out of them." (Executive-Owner 8)

While another participant described their operations as follows,

> "[F]oundries, we very seldom melt raw or maybe we always use scrap metal that is already been processed in the industry or from our own customers" (Executive-General Manager)

Hence, this is a description of materials looping circular economy intervention.

5.6. Factors Enabling (Inhibiting) Circular Economy Implementation

Participants were asked three questions as a part of the research study to answer the research question. These questions explore the main factors that could inhibit and enable the implementation of a circular economy by SMMEs. In addition, it explores the main factors that will make SMMEs want to consider circular business models.

Overall the study identified more barriers and challenges compared to the factors for implementing the circular economy interventions and the factors that will make SMMEs want to consider circular business models.

As such, most of the barriers and challenges were within the environmental dimension of STS (Appendix 9). In addition, environmental factors dominated both the factors for implementing circular economy interventions and factors that will make SMMEs want to consider circular business models. At this level, no other similarities were noted on either social or technical dimensions.

Detailed findings will be discussing the sections below, starting with the barriers and challenges to implementing circular economy interventions. It will be followed by the factors for implementing circular economy interventions and factors that will make SMMEs want to consider circular business models.

5.6.1. Barriers to Implementing Circular Economy

Participants were asked an open-ended question regarding the barriers and challenges to implementing circular economy interventions within the manufacturing sector to explore the barriers to implementing a circular economy. However, participants had to give an account based on their experience within their current organisations.

Overall the study identified 11 barriers (Table 2), refer to appendix 10 for diagrammatic representation. Then, applying the socio-technical Systems theory framework, these barriers were further refined into socio-technical systems dimensions .From this exercise, the study identified Technical barriers (Process and Knowledge), Environmental barriers (Stakeholders, Financial/economic and Regulatory) and Social barriers (Culture and People).

In this context, the study has found that the environmental dimensions of the STS theory pose the most significant challenges to SMMEs in implementing circular economy interventions. Thus, the regulatory framework, financial and economic circumstances, and stakeholders are the major hurdle towards adopting the circular economy by the SMEs in the manufacturing sector. These barriers are external to the organisations and form part of the business environment where SMMEs operate.

Table 2

Distribution of factors inhibiting the adoption of circular business models by SMMEs within the socio-technical systems framework

Socio-technical systems	STS Dimension	Identified Barriers	Absolute Frequencies
Social	Culture	Top Manager's values inclination	4
	People	Lack of capacity (Skills)	3
Technical	Knowledge	Lack of CE Knowledge	4
	Process	Poor quality of recycled materials	7
		Cost of implementation	18
Environmental	Regulatory Frameworks	Institutional Barriers (Policy Frameworks and Implementation)	5
	Stakeholder	Customer Attitudes (Non-acceptance of CE Products/Services)	15
		Lack of Customer Awareness	6
		Lack of Government Support	3
		Misalignment between industry stakeholders	6
	Financial/Economic	Lack of access to Funding	9
	Totals		80

Note: Created by owner using data from Atlas.ti.22 software."

Further, the study highlighted some of the intra-organization barriers within both the technical and social dimensions of the STS theory. Accordingly, process and knowledge barriers were quite dominant within the technical dimension. In contrast, the social dimension was dominated by barriers related to people (lack of Skills) and culture within the organization due to the negative attitude of management.

However, intra-organization barriers (technical and social) were not as prevalent as the inter-organizational (Environment) barriers to implementing circular economy interventions. These findings will be supported by the evidence presented in the following sections.

The following section will discuss all findings, including barriers that were only dominant in one population group.

5.6.1.1. Social Barriers

As highlighted in the section above, the study identified the people and culture of the organisation as the primary barriers to implementing circular economy interventions (Appendix 11). Thus, highlighting a lack of skills and top Managers' values inclination (closed mindset) as the two barriers that SMMEs have to contend with to implement circular economy interventions. However, the organisation's culture was not identified as the common theme among participants, while the people barrier of lack of skill was common to most participants.

a) **People**

i. **Lack of capacity (Skills)**

Within the social barriers, lack of availability of skills was identified as one of the common barriers among the participants. In this context, some participants have argued that the lack of availability of skills is the biggest challenge to implementing circular economy interventions.

> "So skills are quite a challenge" (Executive-Owner 1)

Another participant highlighted the need to train their employees to acquire relevant skills to enable their SMMEs to implement circular economy interventions.

> "Besides the cost, it's the training of your staff." (Senior Manager 2)

However, some participants expressed concern regarding the quality of graduates from institutions of higher learning. As such, the participant asserts that this will be a significant challenge in the next couple of years.

> "Schooling universities, they most probably one of the biggest and in the kind of student that actually being released from university as well. I think we're going to have a huge problem in the next few years…" (Executive - Owner 3)

Also noted was an opposing view from one participant who noted that we do not have the skills in South Africa. However, the participant emphasised the absence of mindset as the main challenge to implementing circular economy interventions.

> "But I do think in South African context, we all trying to hide behind. We haven't got the skills, but we actually don't have the mindset, and that is my very personal strong belief." (Executive -General Manager)

Therefore, there are mixed views on the availability of skills as a barrier to implementing circular economy interventions.

b) Culture

i. Top Managers' values inclination

In this context, a few participants have argued that the closed mindset of the top manager is a barrier to implementing circular economy interventions. As such, it highlights that how the top manager perceives circular economy would determine the level of effort and their commitment toward circular economy.

> "In all things in life, it's your approach to things. It's your mindset to say are we implementing it or are we not implementing? So that's the main barrier is how do you think about things and is it possible to implement and how much extra work it's going to create? …, so to me the main barrier is your mindset." (Executive - General Manager)

Further, another participant have highlighted the resistance to change and the difficulty in convincing other executives in their organisations about the benefits of circular economy. For example;

> "Uh, the value is not always obvious, so whenever you try to sell an idea, it's not always the evident to those around you." (Executive -Management)

> "The other one [is] resistance to change." (Executive-Management)

In this context, should the top managers have a closed mindset and not be willing to engage in circular economy, they will likely be hesitant to change. Thus, this suggests that the top managers' values inclination is likely a barrier towards implementing circular economy.

5.6.1.2. Technical Barriers

Based on the STS theory framework analysis, the study identified process and knowledge barriers as some of the main barriers to implementing circular economy interventions (Appendix 12).

These technical barriers included the cost of implementation, Poor quality of recycled materials, and a Lack of knowledge as the common themes among participants. However, the cost of implementation was identified as the primary barrier to implementing circular economies.

Further, similar findings were found when comparing the participants' responses between groups of SMMEs affiliated and non-affiliated to any CE-related organisations.

As such, the detailed findings will be presented in the sections that follow in the order of their ranking, starting from process barriers and then knowledge barriers.

a) Process

i. **Cost of Implementation**

Cost of implementation of a process barriers within the socio-technical framework. As discussed in the section above, most participants identified this as a primary barrier to implementing circular economy.

In this context, the participants have argued that changing their operations or project could be very costly due to the high costs of the equipment required to carry out these operations.

> "I think the cost of implementing" (Executive-Owner 1)

"You know, you try to change your project, it could be a lot of cost" (Executive - Owner 6)

"…that's pretty hard to justify when you are trying to improve…environmentally friendly products…, if the costs are going up. And if they [are] significantly more expensive, they become very difficult to sell." (Executive - Owner 2)

"It was the cost to implement. It is the problem." (Senior Manager 2)

Thus, to make the transition or to implement circular economy interventions will require a significant initial investment. As such, some of the participants have argued that they need more capital investment to implement circular economy interventions.

"Environmental investment that you put in, let alone the standards that you need to comply with or to put in place for your product to get to be marketable or to be of the right quality." (Executive - Owner 4)

"I think the shaker machine and the resin plant and all of that cost us an absolute fortune." (Senior Manager 2)

"[T]he financial side would be a downside of it, you know, and at this stage, it doesn't really help when the financial side is a massive downside" (Executive - Owner 2)

On the other hand, some participants argued that the cost to manufacture the products is also high, which challenges them to find a market to sell such products. Thus, they need to balance the tension between retaining their customers, implementing circular economy interventions, and increasing prices. As such, they need to generate more revenue to fund these projects.

"I think most of those sort of the difficult part is the cost normally … any of my clientele are happy to do something that is good for the environment as long as it does not come in at additional cost to them." (Executive - Owner 2)

"There is a slow uptake in this because there is a bit of a cost factor associated with it." (Executive - Owner 1)

Therefore, this leads to the industry abandoning circular economy initiatives as they cannot fund them or generate enough revenue to break even,

> "They could not go through because you don't get the revenue you need for you to go past break even because you are developing those products." (Executive - Owner 4)

Hence, the tension between input costs and the difficulty of selling such products or services is highlighted.

ii. Poor Quality of Recycled Materials

The factors affecting the quality of the recycled materials, as identified by the participants, include the lack of cleanliness of the recycled products and the loss of recyclable materials. Consequently, a few participants have argued that the materials are mixed up. Further, participants highlighted that the collection of recyclables from landfill needs to be managed correctly. Hence, the mixing of materials and a lack of cleanliness.

> "[T]he challenge is at the bottom, the way it is really happening. We are not winning...Everything is just taken to a landfill or the way we collect. We looking at bulk." (Executive - Owner 4)

> "And then it comes to the landfill. In some landfill, there is people picking up while they try to pick up some of the recyclables. Then another truck comes and dumps on top of it." (Executive - Owner 4)

> "Then they drop down the price as long they put something on them,…It does affect us because they pick up some material all over there" (Executive - Owner 6)

Further, one participant argued that poor-quality recycled materials harm their operations quality of the products and increase the operations.

> "So we do not like things that have paint on or… galvanising or rust because it makes the metal in the furnace very dirty and it makes the castings have more

issues such as holes or bubbles or anything like that. And then we have to use more… to clean the metal, which costs more money" (Senior Manager 2)

b) Knowledge dimension

i. Lack of CE knowledge

A few participants claim that they have implemented circular economy in their operations and have been practising this for some time. However, as a general observation, participants limited the circular interventions to recycling.

> "I think the circular economy is the theory and the name behind it. But you know, we do practice that…" (Executive –Owner 2)

> "… yes, it is the recycling process, I suppose." (Senior Manager 2)

Thus, participants in this case limit circular economy environmentally friendly products and recycling. However, one participant, in their concluding remark, indicated that they had to "google" the concept to understand what it is.

> "… I googled it quickly on the internet as to what it actually was[sic], and I think it boils down to a sort of common basic business practice that's been given a name." (Executive-Owner 2)

Further, it supports the claims of a lack of knowledge of the circular economy concept. Thus, most participants have reduced circular economy to "common business practices".

On the other hand, some participants have also expressed that end users need to be educated on the role of circular economy. However, the language used made reference to recycling, thus suggesting the participants understand circular economy as recycling.

> "I think one of the challenges faced is the lack of knowledge that we seem to find that is out there at the moment." (Executive - Owner 1)

However, as suggested by one participant, there needs to be a more shared understanding of the circular economy concept. Hence, this suggests that this lack of

shared understanding of the concept presents a challenge to implementing circular economy.

> "Common understanding is one. And by that I mean, you know, you spend time with God on the mountain, then you come down, but everybody else is still doing business as usual. So just having a common understanding. It is typical obstacle." (Executive -Management)

As such, this provides supporting evidence that a lack of knowledge results in multiple interpretations of the concept and thus further creates a barrier towards implementing circular economy interventions.

5.6.1.3. Environmental Barriers

From the STS framework, environmental barriers consider financial /economic circumstances, regulatory frameworks and stakeholders (Appendix 13). As such, the study has identified barriers linked to the stakeholder dimension of the STS framework as the primary barriers to implementing circular economy. Then closely followed by barriers related to the regulatory frameworks and financial/economic circumstances, respectively.

However, when comparing the overall findings between the CE- organisations affiliated and non-affiliated SMMEs, financial/economy barriers, rank higher than regulatory frameworks barriers. Furthermore, although the Stakeholders' barriers remain primary barriers, this is contrary to the findings of the entire population. Thus, most participants from SMMEs affiliated with CE-related organisations are mainly concerned about implementation costs.

The rest of the identified environmental barriers will be presented in the following sections, starting with stakeholders, then regulatory framework and lastly, financial /economic circumstances-related barriers.

a) Stakeholders

The study identified five barriers to implementing circular economy interventions within the stakeholder dimension. These barriers included the non-acceptance of CE products

and services, lack of customer awareness, misalignment between industry stakeholders, and lack of government support.

Though there are commonalities among other barriers, negative customer attitudes are predominant among participants from SMMEs not affiliated with CE-related organisations. On the other hand, misalignment between sector stakeholders is predominant among participants from SMMEs affiliated with CE-related organisations.

In this context, most participants highlighted negative customer attitudes as the primary barrier to implementing circular economy interventions. This was closely followed by a lack of customer awareness, misalignment between industry stakeholders, and lack of government support.

i. Lack of customer awareness

Further, some participants highlighted the lack of awareness by the customers as another barrier to implementing circular economy interventions. As such, participants argued the need for consumers' role in recycling. Further, participants indicated that they should be educated on the product's environmental impacts to increase their understanding and awareness.

In this context, one participant asserted;

> "When I say lack of knowledge, we are talking about the end user and the important role that they play in the circular economy through their efforts of recycling." (Executive - Owner 1)

Similar sentiments were expressed by participants from SMMEs working with the refurbished products. The findings suggest that more awareness is needed to implement circular economy interventions. For example;

> "[T]hey don't understand that the re-machining of the equipment, the re-welding up and the re-machining is just as good as a new component." (Senior Manager 1)

> "And according to research that has been done one valve can work ten years before you before you throw it away. You can use it, repair it, use it, [and] repair it ten times. ...if you repair a valve or any part, you must charge 60% of the value. But they keep on paying 100% and throw away these that are damaged or something is wrong on it" (Executive - Owner 5)

On the other hand, some participants expressed that end users need to be educated on their role in the circular economy. However, the language used made reference to recycling, thus suggesting the participants understand circular economy as recycling.

> "If you could sort of educate more on the down side of some of these products and what did we are doing to the environment then I think that would be another hurdle over it." (Executive - Owner 2)

Thus, should the customers be aware of such benefits, they will likely change their behaviours. Therefore, this reaffirms a need for more awareness as a barrier to implementing circular economy.

ii. Lack of government support

In general, a few participants highlighted a need for more government support as one of the hurdles to overcome to implement circular economy interventions. Thus, participants asserted a need for coordination on the government side and more support for actors within the ecosystem willing to implement specific processes. However, the general view is that the government is not offering enough support and lacks follow-up mechanisms.

> "[G]etting support [from] the government on those people who are starting doing the collecting and recycling" (Executive - Owner 4)

> "…which government doesn't start it on itself, but at the same time it cannot support people who want to start in doing that." (Executive - Owner 4)

> "But the government, one of the things that I think they are lacking, they are not doing follow up on these things. They're giving you these machines. They also not help you to market, to open more doors" (Executive - Owner 5)

This highlights the government's role in creating an enabling environment for the manufacturing sector to implement circular economy interventions. Thus, more government support should be needed for SMMEs to implement these interventions.

iii. Non Acceptance of CE products and Services

Most participants ranked negative customer attitudes as a critical barrier towards implementing circular economy interventions. Thus, the customer is focused on the price of the product rather than the environmental impact of such products.

Although incentives have been issued to return the packaging (containers), this did not alter the customers' behaviour. As such, they returned the containers in a state that they could not be reused, resulting in such containers being sent for recycling.

> "I'm not probably looking at a government initiative...we wanted to try it in the past, like a reward structure for returns of containers things like that but it's again probably a mindset thing… you know with the consumer it's just easier to use the products and throw the container away to be honest." (Executive - Owner 2)

On the other hand, participants have also generally noted a negative perception of refurbished goods and products made from recycled materials. In this context, there is a shared view that refurbished products are inferior to new ones.

> "[T]he client, they can tend to think that refurbished equipment is not the same as new equipment. So the tendency is to think that most probably, the equipment that has been refurbished has lost the lifespan…, which is not true. So refurbished equipment can be exactly the same lifespan, but yes, there is that tendency to think that refurbished equipment is not as good as new equipment" (Senior Manager 1)

As with recycling-related goods, recycling-related goods were perceived similarly by consumers.

> "People are already used to gold and silver, and it is a challenge when you come with something different, something that is big, and you are telling them that this used to be a bottle." (Executive - Owner 8)

This leads to a general lack of acceptance of these products and thus diminishing the market size.

> "When it comes to things such as recycling or manufacturing products, some people are not used to [them]. When you tell them that this used to be something that has been used before, they do not want to use it. They do not like goods that have been used before. They want something new. And the challenge that I have experienced already as a business on the side of jewellery." (Executive - Owner 8)

The impact of this negative attitude by the customer further results in business customers not releasing the equipment to SMMEs who need to refurbish them. Thus negatively impacting the ecosystem;

> "…it is getting you know the clients to release the goods because remember these equipment are in continuous production mode all the time and then getting them to release the equipment for that period of the remanufacturing of the equipment." (Senior Manager 1)

As a result, the consumer (customer) mindset has been highlighted as a barrier to implementing circular economy interventions. Thus, it leads to a need for more acceptance of refurbished products and goods manufactured from recycled products.

iv. Misalignment between industry stakeholders

A few articipants have highlighted a need for coordination between stakeholders and the sector. Thus, the waste management process could be better coordinated, and most steps happen in isolation.

> "It is misalignment within all the groups and the sectors that are involved. You have got waste being a challenge…You find that when it comes to bringing solutions or supporting the implementation of recycling or recovering…There is no link between waste management or getting support from [the] government on those people who are starting doing the collecting and recycling, and at the same

time, you find that even the guys who are recycling to make raw materials, cleaning that product so that it can be used." (Executive - Owner 4)

As such, this hampers the efforts to implement circular economy and further creates a hurdle for SMMEs to implement any proposed circular economy interventions.

b) Regulatory Frameworks

i. Institutional Barriers – Policy Frameworks and Implementation

In this context, some participants have argued that multiple regulations create a barrier as the sector cannot know and understand these regulations. As such, a lack of familiarity with these regulations and the associated red tape thus impedes the manufacturing sectors from implementing circular economy interventions. Thus, participants have highlighted the following;

> "There were a lot of regulations that [we were] unfamiliar with, and they were almost like a hurdle." (Executive - Owner 7)

> "You can make a very good product to anything, but the thing is, there is too much red tape. You want to get that product in the market." (Executive - Owner 4)

On the other hand, another participant indicated that the current business environment driven by various policies does not support the manufacturing sector. As such, a few participants highlighted ta policy shift from stimulating the local industry to allowing more foreign imported products and services.

> "The culture of our country is changed. They focus into distributing finished products and the efforts to try and boost manufacturing in our country is very little and that's why." (Executive - Owner 4)

> "[T]his current political situation where the cadre-ship that has been hanging, it doesn't allow the right people for the right job being charged with implementing and makes something like this happen." (Executive - Owner 3)

Further, another participant argued that there is sufficient knowledge in other markets that can be adapted to the South African context. As such, the government does not have to reinvent the wheel. However, there is a need to firm up the current legislation.

> "In terms of legislation, I think it needs to be firmed up so that Industries and companies have a firm guideline to work with, either set by government or…, a group of expertise [sic] on how this can happen. The reason why I say that it's nothing new. The information is out there globally. It's happening globally at the moment. So they do not need to reinvent anything. It's just adopting from other markets how they deal with the circular economy." (Executive - Owner 1)

On the other hand, some participant argued that more policies must be implemented that target a circular economy.

> "I think it's at the slow pace that government implements some of its programs targeting the circular economy" (Executive - Owner 1)

> "[T]he government framework is there, but implementation is zero." (Executive - Management)

As such, participant highlight that the current policy framework creates much red tape. However, on the other hand, a lack of policy implementation provides the industry with no direction regarding the progression of circular economy. Hence, a barrier to implementing circular economy interventions in the manufacturing sector.

c) Financial/Economic Circumstances

Under this theme, a few participants highlighted the need access to funding as the main barrier to implementing a circular economy. As such, the a few expressed that they need funding to access the relevant technology and equipment to set up their operations in line with the circular economy practices.

i. Lack of Access to Funding

Access to funding is one of the main barriers impeding SMMEs within the manufacturing sector from implementing circular economy principles. As such, a few participants

highlighted that they require the funding to access the respective technology and the equipment necessary to set up their operations in line with the circular economy requirements.

Evidence from the operations that have implemented circular economy is that the equipment is costly and, in certain instances, has to contend with the production downtime to transition to circular economy.

> "Access to funding to get technology does prevent us a little bit, especially smaller businesses to implement things. So yes, it can definitely [be] a barrier if you don't have access to funding to invest into the new technology." (Executive -General Manager)

> "You need enough funding …, and you need to make sure that you are well equipped with equipment, but it's not just equipment you need… also our funding models are very out when they find you; they will fund you and give equipment and maybe a little bit of that,..." (Executive - Owner 4)

> "I think the main thing would be funds for the manufacturing goods." (Executive - Owner 8)

Further, circular economy is seen as experimental; sufficient funding is required for research and development. However, due to inadequate funding, SMMEs abandon the project halfway as they battle to get the necessary revenue to continue funding the developments.

> "If there is no funding available to change technologies or experimental things or change the way you do that, it can be a problem." (Executive -General Manager)

> "Because now you only just being funded [for] the machine and they say, then you're done. Or maybe you're given a six months working capital." (Executive - Owner 4)

Accordingly, funding is one of the most significant obstacles to implementing circular economy initiatives.

5.6.2. Factors Enabling Implementation of Circular Economy Interventions

Participants were required to respond and provide insights based on their personal experience on the factors that can enable or have enabled their organisation to implement circular economy interventions.

Based on the socio-technical System framework, 14 factors were identified across various STS dimensions (Table 3). Additional details provided in appendix 14). These factors were spread across multiple STS dimensions such as people, goals, processes, regulatory frameworks and others.

Consequently, other factors such as innovation, availability of feedstock, and markets for those products were also identified. Nevertheless, the absolute frequency of these factors was low, indicating that they were not comparable among the different groups of SMMEs (CE-affiliated and non-CE-affiliated). As a result, this document will not discuss these factors in further detail.

Table 3

Distribution of factors enabling the adoption of circular economy interventions by SMMEs within the socio-technical systems framework

Socio-technical systems	STS Dimension	Identified Factors	Absolute Frequencies
Social	People	Capacity Building (Training)	3
	Goals	Management Commitment	7
Technical	Knowledge	Knowledge and Understanding of the CE Concept	3
	Process	Availability of Feedstock	1
		Innovation	1
		Operational Benefits	10
Environmental	Regulatory Frameworks	Institutional pressure (Government)	2
	Stakeholders	Government Support	9
		Market Availability	1
		Sharing best Practices	6
		Stakeholder Collaborations	10
		Customer Awareness and Pressure	7
		Ecological Concerns	3
	Financial/Economic Factors	Availability and Access to Funding	8
	Totals		71

Note: Created by owner using Atlas.ti.22 software.

In general, most of the factors enabling SMMEs to implement circular economy were environmental factors within the stakeholders and the socio-technical system's financial /economic dimension of the framework.

In addition, established factors included government support, access to and availability of funding, sharing best practices, customer awareness and pressure, and ecological concerns. Below, we will discuss each of these factors.

5.6.2.1. Social Factors

a) Goal Dimension

i. Management Commitment

In this context, participants have identified management commitment as one of the social factors within the cultural dimension that can enable SMMEs to implement circular economy interventions.

As such, some participants asserted that top management with the knowledge of circular economy could steer their organisation to implement circular economy interventions (Appendix 15). However, more than having the knowledge and understanding of the circular economy may be required to support the transition to the circular economy actively.

As such, participants highlighted that circular economy should be embedded in the organisation's values and that a shared vision should be created, as this makes it easy for SMMEs to implement circular economy interventions.

> "[I]f it is in your company values to be more sustainable. That is one of your values that you use for selling things for, for promoting your business. It will also drive that you actually implement that. So if it is part of your core values, you will drive the circular economy." (Executive -General Manager)

> "… My management commitment… If you're determined to do something, you know you tend to put a lot more resources to it. So management commitment" (Executive -Management)

> "… sometimes it's just easier to implement something when the people that you are in the same room [with] have got a shared vision and you do not even need to sell the story" (Executive -Management)

Thus, this suggests that management commitment enables managers to allocate the necessary resources required to implement circular economy interventions. In addition,

having a shared vision embedded in the company's purpose can enable SMMEs to implement circular economy interventions.

People Dimension

i. Capacity Building (Training)

Lack of availability of skills was identified as a potential barrier to implementing circular economy interventions. As such, it is not surprising that SMMEs not affiliated with CE-related organisations highlighted capacity building (training) as one of the critical enablers to implementing circular economy interventions (Appendix 15). Thus, a few participants see education as a better alternative to resolving the skills challenges.

> "And then above all, I think the school is important, that we have to teach our employees and those that are coming in the industry. That there must learn about the recycling" (Executive - Owner 6)

> "but it is going to all come back to that in my opinion, but some sort of subsidy again back down to some sort of education … this is a better alternative… a lot of our industry, the chemical industry would be effective more…" (Executive - Owner 2)

Thus, this emphasises the need to build the relevant skill specific to the industry to alleviate the skills shortage while enabling SMMEs to adopt circular economy interventions. As such, participants further highlighted the importance of mentoring as one of the possible mechanisms beyond the formal education systems.

5.6.2.2 Technical Factors

a) Knowledge dimension

i. Knowledge and Understanding of the Circular Economy Concept

A few participants have emphasised the need for knowledge and understanding of the circular economy as an enabler towards the implementation of the circular economy

(Appendix 16). One participant highlighted the need for more research, workshops, and mentoring to acquire such knowledge.

> "More research I know I need more research…And yes, I need more workshops that is what I learned during this program on the circular economy and also on the business." (Executive-Owner 8)

Though the SMME has no affiliation with any CE-related organisation, one participant alluded to one of the executives having intimate knowledge of the circular economy.

> "No, I do not think our companies [are involved with any circular, but I do know that our director has a very good knowledge of [the] circular economy." (Senior Manager 1)

Further, when the participant was probed on the role the knowledge as an enabling factor towards implementing circular economy, the participant highlighted the following on the strategic direction of the SMMEs and how they operate;

> "…I think he has an intimate knowledge. So yes, I think that is why we are from him driving. And in how it [The organisation] designs and in the way forward for our company…." (Senior Manager 1)

b) Process Dimension

i. Operational Benefits

With circular economy offers an opportunity to exploit alternative raw materials compared to virgin materials. Some participants erred on the side of operating efficiencies through the cost-saving benefits offered by implementing circular economy interventions (Appendix 16).

In this context, SMMEs highlighted the reduction in the quality of the virgin materials required as input into their operations. Therefore, arguing that recycled materials can be used together with virgin materials, thus supporting SMMEs to save on raw materials costs.

> "[I]t [is] because of an advantage on the costing issue. You have to plan, recycle it with the virgin to keep up with the cost and then avoid too much waste of what to buy…" (Executive - Owner 6)

Further, some participants highlighted the potential cost savings as the byproducts that can be recycled do not have to leave their premises, thus saving on transport and additional labour costs.

> "We do not have to take it off the property, meaning that we don't need trucks on the road to go dump it or drivers. So we have cut out a lot of labour costs and vehicle costs…we can reuse it using a chemical to rebind it..." (Senior Manager 2)

Thus, supporting those cost-saving opportunities is of the potential drivers for implementing circular economy interventions.

> "…again efficiency would be one of the important factors…" (Executive - Owner 2)

ii. Availability of Feedstock

Availability and access to feedstock are essential for every business to run its operations. In this context, SMMEs have identified that feedstock needs to be readily available. Furthermore, feedstock's availability further determines the operational cost (materials costs), which gets passed to the end user.

As such, one participant argued that feedstock availability is one of the primary factors for implementing circular economy interventions (Appendix 16). For example, one participant highlighted that South Africa has a lot of plastic waste materials;

> "…there is ample amount of feedstock available, within South Africa. And in the Western Cape itself, there is a lot of feedstock... So as long as you have [feedstock]. In order for us to implement our project." (Executive – Owner 1)

> "That Stramonium, which grows well in South Africa in the maize, sunflower and soya farms. And it happens because of our weather conditions… When the plants

grow, it becomes rich in this [Scopolamine], compared to other species of plants in the world because, you know." (Executive – Owner 7)

Thus, access to the feedstock mitigates transportation costs, thus positively impacting production costs and enabling SMMEs to implement circular economy interventions.

5.5.2.3 Environmental Factors

a) Regulatory Frameworks

i. Institutional pressure

Many governments push circular economy policies to meet their sustainable development goals and to achieve net-zero carbon economies—this thrust compliance to these policies and other supporting policies into the spotlight.

In this context, a few participants from SMMEs not affiliated with CE-related organisations highlighted the role of institutional pressure as a potential driver for implementing circular economy strategies (Appendix 17). As such, the participant said,

"… the National Environmental Management Act in terms of the Bill of Rights includes the Constitution of South Africa; the citizens of South Africa have the right to [the] environment, for the environment to be protected and to live in an environment that is not harmful to human health or well-being" (Senior Manager 2)

Therefore, this highlights the role of the regulations as the driver towards the implementation of the circular economy.

"…, legislation and so on that drive us to do the changes" (Senior Manager 1)

b) Stakeholders

i. Government Support

In this context, most participants highlighted the role of the government in creating an enabling environment that can support SMMEs to implement circular economy interventions (Appendix 17). Further, the government has a role in ensuring the manufacturing sectors' development rather than focusing on importing goods.

> "So you need an enabling environment to do some of these things, especially when you start talking about recycling…Because the environment doesn't produce the carrot or the sticks." (Executive -Management)

> "[O]ne of the enabling factors for us to get involved in this circular economy is I think their drive and their passion to make sure something like this is implemented so you know, that's the support that we are getting from those organisations within the local and provincial government authorities" (Executive - Owner 1)

Although the government offers some support, in general, more than the current financial support offered by the government is necessary to foresee these projects from inception to completion. As such, a few participants have argued that government should consider developing and implementing policies that incentivise SMMEs and provide rebates for SMMEs that adopt circular economy interventions.

> "…Help [sic] me with the grant of 50%…and then [had] my own 50%... and then we started the show." (Executive - Owner 5)

> "I would think some sort of subsidy to encourage it you know is again I'm going back to cost" (Executive - Owner 2)

Therefore, this emphasises the role of government in supporting SMMEs to implement circular economy interventions.

ii. Customer awareness and pressure

Participants generally identified customer awareness and pressure as other factors that could drive the implementation of circular economy interventions. In this context, a few participants argued that the increased awareness of customers (Appendix 17), in particular Gen-Z, will push SMMEs towards implementing circular economy interventions.

> “So what we are finding is that as the younger generation or the gen-Z or I think they call them now, I am not too sure…, but they are very conscious of where their products come from.” (Executive - Owner 1)

Therefore, increased customer awareness informs the customers’ purchase intentions. In this context, customers want to feel that they are contributing to finding solutions to address the current environmental challenges.

> “And I think as time goes on… more people will start to focus on, what products they buy in future. You know if it’s a recycled part of a circular economy because people want to feel that they are making a difference.” (Executive - Owner 1)

Consequently, this purchase intention influences SMMEs to implement circular economy interventions to retain their customer base.

Further, for business-to-business customers, compliance with the legislation has been used to apply pressure on suppliers to implement circular economy interventions. In comparison, a few participants have indicated that implementing a circular economy is becoming a prerequisite for supplying international clients and customers. Therefore, this suggests that customer pressure drives SMMEs to implement circular economy interventions.

> “Clients are driven by these legislations then it does drive us to do the changes as well.” (Senior Manager 1)

> “[T]he problem is especially if you supply international, you start getting measured on that and it is a prerequisite when you have got new customers that you actually comply with that” (Executive -General Manager)

Therefore, customer awareness leads to customer purchase intentions and change in behaviour and thus a source of pressure for SMMEs to implement circular economy interventions.

iii. Sharing best practices

As the circular economy remains an emergent concept, a few participants identified sharing best practices as another factor that could enable SMMEs to implement circular economy interventions (Appendix 17). In this context, international corporations have been sharing knowledge and best practices with local SMMEs to encourage and support SMMEs to implement circular economy interventions. As such, participants argue that,

> "There was a lot of support from that side, more on the knowledge side than really anything else to assist you to do that, just to share some of the knowledge and examples of what they have seen in other companies, which helps because they just broaden your perspective on what other people actually doing in the same industry" (Executive -General Manager)

Though a few participants have argued that industry bodies need to provide them with financial support, they view these bodies as platforms for exchanging information on products and technologies with their industry peers.

> "So the SA Plastic Pact is not going to help us to do that. It's a nice information sharing sessions…" (Executive - Owner 1)

Similarly, there are informal bodies that various stakeholders have created for the sole purpose of sharing knowledge and practices. For example, there is an informal organisation called FETULA that addresses recycling issues to the community member interested at no cost.

> "I am already on one program… as much as my aim is to recycle… And yes, I need more workshops that is what I learned during this program on the circular economy…" (Executive-Owner 8)

In this context, the findings suggest that through information-sharing sessions, SMMEs can benefit from the best practices, which, in turn, will help that deal with the potential barriers to implementing circular economy interventions.

iv. Ecological Concerns

Another factor raised by a few participants influencing the implementation of the circular economy business interventions was ecological concerns (Appendix 17). These factors include the impacts of global warming and pollution and their impacts on climate change on farming, food security and health issues.

As such, there are environmental concerns such as global warming, and this potentially could decimate the planet. It is potentially leading to an existential threat to many businesses.

> "I think it's loud and clear with all the news that's coming out that we are facing catastrophic Global issues in terms of climate" (Executive - Owner 1)

> "And sort of environmental issues and…, more environmental solutions aren't as effective…." (Executive - Owner 2)

> "We are not dumping rubbish sand, which means it's better for the environment." (Senior Manager 2)

Therefore, ecological concerns are drivers for SMMEs to implement circular economy interventions. Subsequently, failure to implement such measures will lead to the existential of most SMMEs.

v. Stakeholders Collaborations

Given that SMMEs do not have access to funding, a few participants have highlighted the need for partnership to gain access to financial support and relevant skills required for circular economy. In this context, participants have argued for small enterprise development as one of the critical enablers for SMMEs to implement circular economy intervention.

> "…enterprise development programs from big, large corporations" (Executive - Owner 1)

> “It is small enterprise development and who could give us a loan to go ahead and work with us to say look will help you to push until you the business comes your profitable point while you put all the systems in place” (Executive - Owner 4)

> “The alliance, together with their partner called Plug and Play, will coach us,… or whoever I choose so that we can pitch to global entities” (Executive - Owner 1)

Further, one participant highlighted that through these collaborations, there are possibilities to have access to markets and investors and mentorships.

> “An organisation like Alliance to End Plastic Waste is an organisation that can give us that scale that we are looking for. Access to markets, access to investors, access to… investors that are focused on the green economy, focused on circular economy, focused on climate change issues where they want to put their money in that.” (Executive - Owner 1)

Therefore, this provides an opportunity to find synergy and leverage for these partners depending on the challenge the SMMEs face regarding implementing circular economy interventions.

> “I undoubtedly simply why I say that, because you will find the synergies in some of these partnerships and collaborations. And the perfect example I just mentioned now is that these are chemical companies… they will be looking to collaborate with companies like ours.” (Executive - Owner 1)

However, most notably, the participant further highlighted that circular economy requires the involvement of multiple actors beyond the industry players and the government. As such, circular economy requires the involvement of all stakeholders, including society.

In describing the involvement of all stakeholders, the participant argued that circular economy is not like the mining industry, where actors want to own all mining operations for their benefit. However, circular economy is a problem everyone needs to own, and the opportunity should benefit everyone.

> “[For] the circular economy to grow…, it is not a mining industry. You know the mining industry, you want to own everything… you want to own the land, you want to own the machinery, [and] you want to control everything. You cannot with

this. This is a problem that everybody needs to own and the opportunity must benefit everybody at the same time. The collaborators, your partners, society and definitely the earth itself." (Executive - Owner 1)

Thus, implementing the circular economy interventions requires the involvement of multiple stakeholders, as each has a different contribution. As such, this could benefit SMMEs and address potential challenges related to implementing circular economy interventions.

c) Financial/Economic Circumstances

i. Availability and Access to Funding

Further, some participants highlighted the importance of funding (Appendix 17). In general, availability and access to funding will support SMMEs in acquiring the necessary technology and equipment required to implement circular economy interventions.

In this context, some participants argued the need to have access to both government and private funding as the biggest drawcard for SMMEs to implement circular economy interventions.

"…, economics and then your availability of funding is a big one" (Executive - General Manager)

"For more support in the form of additional resources and funding. So one of the biggest draw cards to this and I think for us as a medium company is the access to global investors" (Executive - Owner 1)

Further, some participants asserted that large organisations have funding to get their operations to comply with the regulations; therefore, the same cannot be said for SMMEs. Although there are finding available from the governments, participants further indicated that the private sector as the private sector had got a better understanding of the requirements.

> “You know, is that logic corporations have generally got funding and things like that to be more environmentally friendly. The smaller corporation, when it comes with significant cost, it generally is not a focus of business.” (Executive - Owner 2)

> “Funding from private sector was much better, we never got [a] cent even from the government because they did not seem to understand.” (Executive - Owner 4)

Thus, with access to funding, SMMEs can acquire the necessary technology and equipment required to implement circular economy interventions.

5.6.3 Factors enabling the adoption Circular Business Models

Participants were required to respond on the factors that will make or have made their organisations wants to consider different business models. Thus, providing insights based on their experience and understanding of circular economy principles.

The study identified 12 factors that could enable SMMEs to adopt circular economy business models within the social, technical, and environmental systems of the STS framework (Table 4), additional details in appendix (18). Most of these factors came under the Financial/Economic circumstances, stakeholders, and process and people dimensions of the socio-technical framework.

Several other factors were also identified, including management commitment, (i) access to new markets, (ii) reputational risk management, (iii) partnerships, (iv) proximity to customers, (v) innovation, (vi) information access, (vii) a shift in consumer attitudes, and (viii) sharing best practices.

Although some of them had a low absolute frequency, further analysis revealed that some of these factors were similar to the factors identified under the factors that could

enable SMMEs to implement circular economy interventions. These factors included—management commitment and sharing best practices.

In this context, there remaining factors were prevalent among individual participants. As such, there were no themes identified across participants on these factors. Consequently, these factors will not be discussed in detail in the following sections.

Most of the factors that could enable SMMEs to adopt a circular economy were predominant in both social and technical systems. These included government support, economic gains (profitability), and ecological concerns.

However, other factors identified were only dominant in one group or the other. These factors were common between themes with thin the participants form the respective groups (CE- related organisations affiliated and non-affiliated SMMEs. As such, they included social and environmental factors within the people and stakeholders dimensions, respectively.

The following sections will present the key findings for the factors that could enable SMMEs to adopt circular business models.

Table 4

Distribution of factors enabling the adoption of circular business models by SMMEs within the socio-technical systems framework

Socio-technical systems	STS Dimension	Identified factors	Absolute Frequencies
Social	Goals	Management Commitment	4
	People	Knowledge and Skills	4
Technical	Buildings/Infrastructure	Proximity to customers	1
	Process	Reputation Risk Management	2
		Economic Gains- Profitability	8
	Knowledge	Access to Information	2
Environment	Stakeholders	Access to New Markets	9
		A Shift in Consumer Attitudes	1
		Government Support	6
		Partnership	1
		Sharing best Practices	1
		Socio-ecological benefits	11
	Totals	Totals	50

Note: Created by owner using Atlas.ti.22 software.

5.6.3.1 Social Factors

a) People Dimension

i. Skills and Knowledge

The population group identified skills and knowledge as enablers for adopting circular economy business models (Appendix 19). In this context, some participant argued that the diversity in the knowledge that different employees could bring into the organisation. While other participants asserted that education should be the focus to develop the appropriate expertise required for adopting a circular economy. For example;

> "That is a form of education that are that are also going back to is that we have to educate these guys" (Executive - Owner 3)

> "You want to get more value, appropriate people… In some cases there's a strong business sense" (Executive -Management)

> "[I]f there will be more employees - different people, will be able to contribute different skills" (Executive - Owner 8)

Thus, skills and knowledge can be crucial in adopting circular economy business models.

5.5.3.2 Technical Factors

a) Process Dimension

i. Economic Gains- Profitability

Some participants identified economic and financial benefits as the primary driver for adopting circular business models (Appendix 20). As a result, participants noted the operational benefits of reclaiming byproducts (such as sand) otherwise disposed of in the environment. Thus, these savings contribute to the bottom line of the organisation. As such, the majority argued the financial benefits of adopting circular business models.

> “I think the first factor is economics. So if you can save money and become more profitable by implementing that it, it will definitely be a driving factor. It’s the financial implications of implementing that that is definitely a driving factor.” (Executive -General Manager)

> “When I say financials, I meant as in cost. So the when you are going to restructure …, what can you save on costs? What cost could you share with other companies, that sort of thing … would be something that would drive something like that for particularly a sort of micro enterprise” (Executive - Owner 2)

> “All the scrap yards that are the middlemen are making a killing because they collecting all the scrap from our customers and then selling it back to us. Whereas now what we do is we go back to our customers and say when you do not need it, we will buy it directly back from you.” (Senior Manager 2)

Further, participants also noted the secondary benefits of adopting circular business models, such as the social and environmental impact. However, profitability remained a predominant driver for adopting circular business models. For example

> “So we want to get the benefit from the circular economy, not just going to the bottom line of profit, but definitely going to impact” (Executive -General Manager)

Thus, making financial and economic benefits are a driver for SMMEs to adopt circular business models.

b) Process Dimension

5.6.3.3 Environmental Factors

a) Stakeholders

i. Socio- Ecological Benefits

Some participants highlighted climate change as impacting food quality and social factors such as health. Some participants highlighted the positive impacts of adopting circular business models on the environment and health issues. As demonstrated below,

some participants (Appendix 21) have indicated not dumping “rubbish” sand into the environment. The participant asserted,

> “We are not dumping rubbish sand, which means it is better for the environment.” (Senior Manager 2)

> “And then we keep the country clean and then process it in a good manner that would produce quality out of those recycled material.” (Executive - Owners 6)

Thus, while keeping the country clean, there is also an economic benefit associated with using recycled materials as raw materials in the production processes.

On the other hand, one participant expressed concerns regarding the level of pollution. In this context, the level of pollution in the ocean is impacting marine culture. This impacts society’s well-being, which could create an existential threat for many businesses due to a lack of customers.

> “The health issue. So I mean, we can’t just keep eating the fish out of the ocean and throwing the plastic back in there and expecting to live…If you look at the quality of our foods, so all these things have an impact. The rise in health issues. You know, so in terms, if you look at, so if your customer dies or doesn’t exist anymore, why are you in business? Who are you going to sell to?” (Executive - Owner 1)

> “I mean, farming itself is already affected by global warming” (Executive - Owner 1)

Further, one participant argued that, with circular business models, there is a potential for a second revenue stream. Moreover, through this revenue stream, employees can economically benefit, for example, through recycling.

> “…we are trying to take the impact part and say how can I help my people inside the foundry to become more economically stable by using waste to create second revenue streams or to recycle or…” (General Manager)

Thus, putting social and environmental benefits as one of the primary drivers for adopting circular business models.

ii. Government support

In this context, some participants have highlighted the need for government to create an enabling environment that promotes circular economy principles (Appendix 21). As such, the government can further encourage SMMEs to adopt circular economy business models by implementing incentive programs for SMMEs willing to adopt circular business Models.

> “Funding incentives… I’m not saying, you know, get it for free. But I’m saying, you know, there must be some sort of incentives for business people to go this route.” (Executive - Owner 1)

Further, participants asserted that government should also procure from these small companies to offer support and stimulate the manufacturing sectors. Thus promoting busying local products and service stimulates activities within the manufacturing sector.

> “If the government of South Africa was buying [from] a small company like this...” (Executive-Owner 5)

> “Why are we not manufacturing...Why are they [doing] so little? To make sure that we become one of the world leaders.” (Executive - Owner 3)

Thus participants are calling on the government to support SMMEs to enable them to adopt circular business models.

iii. Access to New Market Segments

A few participants highlighted that adopting circular business models has expanded their markets to include other segments of the markets they would normally not consider (Appendix 21). For example, the rental model for a company that designs electrical machinery has provided access to small mining businesses. These generally would fall outside the traditional market.

> “So then they will go on a rental rather rent the equipment. They’ll also use our operators because… so they rent their equipment, they pay for the operators.” (Senior Manager 1)

> “[T]hey offer like a rent to buy over a long period of renting or if after a certain amount of time that they’ve rented because they’ve purchased it basically. And then also for a short period of time.” (Senior Manager 1)

Therefore, this asserts that they have opened up a rental market, which further includes paying for the operator of such equipment. Further, a new market of “rent-to-buy” allows small mining businesses to rent the equipment over a long-term period.

On the other hand, participants have further argued that adopting a circular economy has enabled them to expand their operations internationally. Therefore, participants argued limited market availability in the African continent and South Africa in particular.

> “The market is not really in South Africa. It is a bit in Africa as a whole. But how much? It is more in China, America and Australia and all these countries.” (Executive - Owner 7)

> “And since we saw that gap. And we have the plant material. We developed an extraction and novel extraction method…. So that’s how we came within this market.” (Executive - Owner 7)

Therefore, this suggests that access to new market segments is a driver for SMMEs to adopt circular business models.

5.7. Conclusions

a) Demographics

The chapter demonstrated that the population demographics included most SMMEs owners from the Chemical (Petroleum and Plastics) manufacturing subsectors. Although there was a variation in the sectoral experience, most of the participants in the study have between five to ten years of sectoral experience.

One of the prerequisites for the study was interviewing participants who were knowledgeable about the circular economy concept. As such, most participants had a

good knowledge of circular economy. However, some participants were novices that also participated in the study.

b) Circular economy experience

Further, participants have had some involvement in circular economy-related projects. Though most participants are familiar with materials looping (recycle, reuse and repair), most participants had between five to ten years of experience in circular economy-related projects. Thus, providing evidence that participants had a firsthand account of being involved in circular economy.

However, in establishing the circular economy experience, a more common understanding of the circular economy concept was needed. Most participants associate the circular economy with recycling, not with designing out waste and pollution, retaining materials and products, and regenerating ecosystems.

The study intended to survey participants from SMMEs that have implemented a circular economy or are in the process of implementing circular economy. In this context, there is evidence that SMMEs were born to be circular.

Overall, evidence suggests that most SMMEs have elements of circular economy practices. In particular, it is recycling and reclaiming of products customers. Thus, most SMMEs have partially implemented circular economy principles that mainly focus on their internal operations.

c) Familiarity with Circular economy interventions

Participants were further assessed on their familiarity with various circular economy interventions. In this context, the study found that most participants were familiar with the circular economy intervention strategy of Materials looping (recycle, reuse, and repair). Therefore, this correlates with the participants' examples of their involvement in circular economy projects. Therefore, this provides further evidence regarding the participants' experiences regarding the circular economy.

However, the study also found that participants were unfamiliar with other circular economy interventions. These included green steel manufacturing technologies and

circular textile design. Accordingly, this supports the view that the South African manufacturing sector is dominated by materials looping circular economy interventions.

d) Barriers to Implementing Circular economy interventions

Regarding the barriers to implementing circular economy interventions, the study identified 11 barriers, with more than half of the barriers within the environmental systems of the STS framework. As a result, the remaining barriers were equally spread between the technical and social systems.

Comparing the barriers between SMMEs affiliated and not affiliated with CE-related organisations revealed that most of the barriers were shared between these groups. These barriers included lack of capacity (skills), cost of implementation, Poor quality of recycled materials, lack of access to funding, Institutional Barriers (Policy Frameworks and Implementation), Lack of government support and Lack of customer awareness.

Some barriers include top managers' value inclination (closed mindset) and non-acceptance of circular economy products and services being dominant in the group of SMMEs not affiliated with circular economy-related organisations.

Overall, the dominance of the barriers from the environmental systems of the STS framework suggests that barriers to implementing circular economy interventions are determined mainly by Stakeholders, Regulatory frameworks and Financial or Economic circumstances. Thus barriers such as lack of customer awareness, government support, non-acceptance of circular economy products and services, Institutional Barriers (Policy Frameworks and Implementation) and lack of access to funding are the main inter-organisations barriers inhibiting SMMEs from implementing circular economy interventions.

Similarly, there were also intra-organization barriers that SMMEs had to contend with before implementing such circular economy interventions. These barriers included cultural barriers, such as top managers' value inclination (closed mindset), people barriers - Lack of capacity (skills) and process barriers, such as cost of implementation and poor quality of recycled materials.

In the same context, other STS dimensions were identified with no barriers. With the majority of these dimensions within the social and technical systems. As such, these systems included goals, infrastructure and technology.

For SMMEs to successfully implement circular economy interventions, intra- and inter-organisational barriers must be addressed.

e) Factors Enabling Implementing of Circular Economy Interventions

Overall the study identified 11 factors that could enable SMMEs to implement circular economy interventions, with less than half of these factors within the environmental systems of the STS framework. The remaining factors were equally distributed between the social and technical systems. However, the study also noted that no factors were identified in the social and technical systems of culture, technology and buildings/ infrastructure.

Comparing the factors between the groups of SMMEs affiliated and not affiliated with CE-related organisations revealed that there were factors that were common between these groups. These factors include the availability of funding, government support, sharing best practices, ecological concerns, customer awareness and pressure and knowledge and understanding of the circular economy concept.

On the other hand, some factors were predominant in respective groups. For example, Management commitment, Capacity Building (training), Cost-saving Opportunities and institutional pressure (Government) were dominant within the group of SMMEs not-affiliated with any CE-related organisations. Meanwhile, feedstock availability was a dominant factor within the group of SMMEs affiliated with CE-related organisations.

Considering that more than half of the factors identified are within the environmental systems of the STS framework, this suggests that SMMEs have to contend with stakeholders, regulatory frameworks and financial/economic circumstances to implement circular economy interventions successfully.

In particular, the government's dual role as a stakeholder and the institution responsible for policy formulation and implementation. Therefore, this suggests that government needs to balance the tension between institutional pressure and support through a

regulatory framework while creating an enabling environment for SMMEs to adopt and implement circular economy interventions.

Beyond the government interventions, the findings further highlight the role of collaborations as one possible lever for SMMEs to implement circular economy principles. As such, SMMEs can gain knowledge by sharing best practices and accessing the necessary funding to implement such strategies.

However, cognisance should also be accorded to intra-organisational factors such as management commitment and capacity building (training) as the enabling factors for implementing circular economy interventions. In this context, the role of management commitment in supporting the SMMEs to acquire the necessary human and technical capabilities to implement such strategies.

Thus, to respond to the pressure from both governments (Institutional pressure) and society (customers), SMMEs need to change their business models. As such, these SMMEs must manipulate their technical and social capabilities to adopt and implement circular economy interventions successfully.

f) Factors Enabling adoption of Circular Business Models

Overall the study identified five factors that could enable SMMEs to adopt circular economy, business models. However, only three of those factors were common to both groups, with the other two being only dominant in the SMMEs not affiliated with any CE-related organisations.

Further, most of these factors were within the environmental systems of the STS frameworks and mainly covered the stakeholders' dimensions. As such, these factors included economic government support, access to new markets and socio-ecological benefits. With the remaining factors, economic gains (Profitability) and skills and knowledge are present in the social and technical systems, respectively.

Thus, for SMMEs to consider alternative business models would require such SMMEs to contend with stakeholders, particularly government support. In addition, SMMEs also need to have the appropriate knowledge and skills to adopt circular business models successfully.

Further, the study observed the absence of factors from the STS framework's financial/economic circumstances and regulatory frameworks dimension. This observation suggests that SMMEs are motivated by ecological concerns, access to new markets and the associated economic gains of adopting circular economy business models. In this context, the findings suggest that government support and the availability of appropriate skills are critical for SMMEs to adopt and implement circular business models successfully.

Although many barriers to implementing circular economy interventions were identified, ecological concerns are the main driver for SMMEs to adopt and implement circular economy interventions and business models. Thus for SMMEs, successfully implementing these interventions and business models would require access to the appropriate knowledge and relevant skills.

Thus, creating an enabling environment that could provide skills and access to funding and foster stakeholder collaborations would require government support. Therefore, the government must develop and implement policies that balance the tension between social, environmental and economic needs.

Overall the chapter articulated the findings based on the design philosophy and the analysis of data procedures in chapter four. In addition, the chapter presented critical findings on circular Demographics, circular economy experience and SMMEs affiliated with circular-related projects. Further, Factors enabling (inhibiting) SMMEs within the manufacturing sector to implement circular economy interventions were presented, including the participant's familiarity with the circular intervention interventions.

Chapter Six: Discussions of the Findings

6.1. Introduction

This chapter aims to discuss the findings in relation to the literature and offer some insights into adopting a circular economy. Thus the chapter discusses the key barriers and enabling factors to implement circular economy interventions. In addition, the chapter discusses the critical enabling factors for the adoption of circular economy business models.

In this context, this chapter discusses the finding related to the familiarity of the circular economy interventions and their relevance to the research question on the factors that could influence SMMEs within the manufacturing sectors to adopt circular economy.

Relying on the socio-technical systems theory, the study identified critical social, technical and environmental factors that could enable (inhibit) the implementation of circular economy interventions and circular business models. Collectively called the implementation of circular economy principles or strategies.

In conclusion, the chapter highlight the barriers, enablers and drivers for adopting circular economy interventions and business models.

6.2. Circular economy experience

The previous chapter established that a more shared understanding of the circular economy concept needs to be shared. Consequently, most participants viewed the circular economy as recycling rather than a more comprehensive concept encompassing eliminating waste and pollution and preserving resources. This view suggests limited knowledge and understanding of the idea.

Thus the circular economy concept is emergent and has multiple non-converging definitions (Murray et al., 2017; Kirchherr et al., 2017; Korhonen et al., 2018; Korhonen et al., 2018a). There are, thus, multiple interpretations of the concept (Homrich et al., 2018; Schroeder et al., 2019).

The lack of convergence and agreement on the circular economy concept breeds the reductionist approach that the industry has adopted. This reductionist approach conceptualises circular economy as reducing, reusing and recycling activities (Kirchherr et al., 2018; Korhonen et al., 2018; Murray et al., 2017), but fails to recognise the role of other stakeholders and actors in the ecosystem (Barreiro-Gen & Lozano, 2020; Nudurupati et al., 2022).

In this context, it is not surprising that most SMMEs claim to have implemented a circular economy. However, these SMMEs include implementing some circular economy aspects, such as recycling. Therefore, driven by the challenges and barriers, SMMEs practice frugality in adopting and implementing circular economy interventions in pursuit of profits (Dey et al., 2020; Ormazabal et al., 2018; Sohal et al., 2022). Hence, the partial implementation of the circular economy.

6.3. Familiarity with CE- Interventions

A circular economy assimilates economic growth with environmental sustainability and physical flow concepts where the flows are reversed (Korhonen et al., 2018; Prieto-Sandoval et al., 2019). This advocate for maximising the duration of the resources spent in a closed cycle (Kalmykova et al., 2018; Korhonen et al., 2018).

As such, dominant circular economy strategies are built on environmental sustainability and reducing the consumption of natural resources by de-coupling economic growth from resources consumption (Bocken & Ritala, 2022; Korhonen et al., 2018; Friant et al., 2020). Therefore, it emphasises resolving environmental issues to avert the collapse of the ecosystem.

Many scholars advocate that when adopting circular economy strategies, organisations should consider strategies that promote product reuse, manufacture and refurbishment to reduce the environmental burden and energy demand (Kalmykova et al., 2018; Korhonen et al., 2018; Prieto-Sandoval et al., 2019).

Hence, the circular economy's focus has been primarily on promoting the main environmental strategies which focus on reducing, reusing and recycling (Kalmykova et al., 2018; Korhonen et al., 2018; Prieto-Sandoval et al., 2019)—commonly known as the 3R strategies.

In this context, it does not come as a surprise that most participants had indicated familiarity with the materials looping (recycle, reuse, repair) circular economy interventions. Moreover, many governments and institutions have adopted the circular economy as a strategic topic (Gilberto et al., 2021).

Therefore, some strategies, particularly those that address environmental issues, would have been formulated into regulatory frameworks. Hence, the high familiarity with the circular economy strategies that promote materials looping.

6.4. Factors enabling (inhibiting) CE implementation

6.4.1. Barriers to Implementing Circular Economy Interventions

6.4.1.1. Social Barriers

For SMMEs to adopt and implement circular economy interventions, the study that SMMEs need to contend with barriers in the people and culture dimensions of the circular economy. In this context, the study highlighted a lack of skills and top managers' values inclination (closed mindset) as the barriers SMMEs need to overcome to implement circular economy interventions.

a) People

i. **Lack of Skills**

Considering the complex nature of adopting and implementing circular economy interventions, SMMEs need access to relevant skills and expertise to support the transition process. Furthermore, as asserted by Hopkins et al. (2018), circular economy setups are dynamic and require faster innovation cycles and capabilities to manage transition (Hopkins et al. 2018).

Access to such skills may require SMMEs to train their employees (Sharma et al., 2018). Alternatively, stakeholders may bring the skills (Journeault et al., 2021). In this context, Journeault et al. (2021) asserted that stakeholders can play complementary

collaborative roles through training or providing a specialist role in supporting SMMEs to implement circular economy interventions.

Thus, SMMEs will likely only succeed in implementing circular economy interventions with access to the relevant skills and expertise. In this context, For SMMEs to succeed would require them to have access to skills and expertise (García-Quevedo et al., 2020; Nudurupati et al., 2022; Sharma et al., 2022) and experience (Sharma et al., 2022).

Therefore, there findings support the current literature that a lack of skill is a barrier to the implementation of circular economy interventions.

b) Culture

i. Top managers' values inclination

Under social barriers, the study highlighted the impact of the closed mindset by top management as another barrier to adopting circular economy interventions. Thus, asserting the closed mindset of top managers leads to hesitant organisational cultures to adopt and implement circular economy interventions (Kirchherr et al., 2018; Sharma et al., 2021).

According to Arieli et al. (2020), top managers affect organisational influence through the tiered approach and play a vital role in determining the organisational culture and climate. Like other employees, top managers strive to conduct themselves with their values (Arieli et al., 2020).

In this context, should top managers have a closed mindset towards circular economy interventions, they are likely to enforce this throughout the organisation, thus creating a culture that counters implementing them. Therefore, informing the strategic choices that SMMEs are likely to make (Arieli et al., 2020).

For SMMEs to adopt circular economy Interventions would require top manager – organisation values congruency in outlining business the necessary business strategies and action plans (Kitsis & Chen, 2021). As a result, a lack of congruence between top managers' values systems may prevent them from implementing circular economy initiatives.

According to Wijethilake & Lama (2019), top management's decisions in resources allocation and deployment to effect change may impact the success of the implementation of circular economy interventions (Wijethilake & Lama, 2019)

In addition, to individual top managers' values and convictions, top management commitment can shape the organisation's responsiveness or inaction towards the promotion of CBM (Yamoah et al., 2022). Thus, the lack of congruency between the manager's value system and that of the organisation would negatively impact the implementation of circular economy interventions.

In this context, Yamoah et al. (2022) asserted that top management's commitment and disposition to participate in CE conversations can hamper or support the successful implementation of circular economy interventions.

Thus, the transition to a circular economy requires top managers' commitment to creating an organisational structure that will foster the circular economy and cultivate employees' commitment (Bertassini et al., 2021; Marrucci et al., 2021).

In this context, a few participants noted that how managers perceive a circular economy would likely harm the transition to a circular economy. Having the perception of a circular economy as "creating extra work" would be a barrier to a circular economy (Executive-General Manager). This supports the literature on top management mindset as a barrier to circular economy implementation.

6.4.1.2. Technical Barriers

Comparing the barriers between SMMEs affiliated and not affiliated with CE-related organisations revealed that most of the barriers were shared between these groups. These barriers included the cost of implementation and poor quality of recycled materials within the process dimension of the socio-technical systems theory. Similarly, the study also identified a need for circular economy knowledge and another barrier to implementing circular economy interventions within the knowledge dimension.

a) **Process**

i. **Cost of implementation**

According to Malik et al. (2020), a major criticism of circular economy adoption is the need for a more fundamental understanding of the implementation of circular economy interventions and the financial outcome of implementing circular business models.

In this context, SMMEs have argued that changing their operations or project could be very costly due to the high costs of the equipment required to carry out this operation. Thus, asserting that the initial capital investment to reconfigure their operations is a barrier to implementing circular economy interventions. According to Gedam et al. (2021), the high investment cost is the most significant barrier to adopting a circular economy.

According to García-Quevedo et al. (2020), the ability to reconfigure the firm's operations depends on the firm's resources and capabilities. As such, the majority of SMMEs lack financial capacity (García-Quevedo et al., 2020; Journeault et al., 2021; Marrucci et al., 2021; Sohal et al., 2022; Sharma et al., 2021), thus not being able to provide the initial capital outlay to fund the reconfiguration of their operations in line with the circular economy principle. SMMEs resort to borrowing to overcome this barrier, which attracts borrowing costs (García-Quevedo et al., 2020).

Consequently, these SMMEs develop inertia towards implementing circular economy interventions (Esposito et al., 2018; Hofmann & Jaeger-Erben, 2020) or partially implementing such circular economy interventions in favour of economic benefits (Dey et al., 2020; Ormazabal et al., 2018; Sohal et al., 2022).

On the other hand, participants argued that product manufacturing costs are also high, challenging them to find a market to sell such products. Thus, they must balance the tension between retaining their customers, implementing circular economy interventions, and increasing prices.

In this context, Korhonen et al. (2018) asserted that some organisations, in particular first movers, may find it very difficult to switch to circular economy due to the high cost for both consumer and the business. Further, despite their superiority, circular economy

products and services must compete alongside the dominant linear economy (Korhonen et al., 2018).

Thus, making it very difficult to break through into the market. As de Jesus & Mendonça (2018) asserted, high initial capital investment and market uncertainty render some products and services unpractical. Consequently, faced with these challenges, SMMEs hesitate to implement circular economy interventions. Thus, fully supporting the current literature which asserts that cost of implementation is a barriers to circular economy interventions.

ii. Poor quality of recycled materials

It is contended in chapter five that the poor quality of recycled materials is a barrier to the implementation of circular economies. Moreover, the study concluded that proper management of recycling from landfills is essential. Thus, negatively impacting the quality of the products and operational costs.

Generally, recycling involves repurposing post-consumer products and post-producing waste into other products and services (Malik et al., 2022; Ranta et al., 2018). Thus consideration should be given to the usable waste (Goninan & Hasanagic, 2018) that meets the quality requirements to repurpose.

As a result, it may become harder to obtain such wastes as the product life is extended (Govindan & Hasanagic, 2018). Thus, the scarcity of recycled will create a high-demand situation resulting in price increases.

Moreover, the supply of recycled materials cannot be guaranteed as the volumes could fluctuate (Paletta et al., 2018). Consequently, forcing SMMEs to either revert to virgin materials (Govindan & Hasanagic, 2018) or be hesitant to implement circular economy interventions.

Further, the recycling sector is dominated by both the formal and informal sectors; it is tricky to control the quality of these materials (Paletta et al., 2018). Finally, due to the nature of the operations, some of the recyclables are likely to be food-heavy which reduces the recycling potential (Ranta et al., 2018), thus requiring SMMEs to incur secondary operational costs (collection, cleaning, and sorting) before processing such

materials (Paletta et al., 2018). Thus, further discouraging SMMEs from implementing circular economy interventions.

The findings of this study lend support to what has been discussed in the literature. A lack of proper landfill management can lead to poor-quality recycled materials, making circular economy interventions difficult.

b) Knowledge

i. Lack of circular economy knowledge

Observations for the study indicated a need for a shared understanding of the circular economy concept. As such, most participants limited the definition of circular economy to recycling activities and the need to make environmentally friendly products.

Thus, suggesting that most SMMEs are spending their efforts on some aspects of the circular economy interventions. According to Barreiro-Gen and Lozano (2020), most organisations implementing circular economy interventions (4R) spend their time on reducing and recycling rather than repairing and remanufacturing. At a micro-level, these interventions support SMMEs in improving their operational efficiencies by improving their internal processes (Prieto-Sandoval et al., 2018)

Further, the dominant interventions propelled in the industry focus on recycling, reuse and repair (Kirchherr et al., 2017; Korhonen et al., 2018; Murray et al., 2017). These are accessible interventions to minimise waste (Katz-Gerro & López Sintas, 2019).

However, Ranta et al. (2018) concluded that recycling is more cost-effective than reuse and reduction operations due to the more negligible impact on the business. Therefore, putting a significant emphasis on recycling reduces the consumption of natural resources to limit environmental impacts. Hence, the claim by SMMEs to have implemented circular economy while referring to recycling activities.

However, these dimensions (recycle, reuse, repair and remanufacture) do not integrate the social dimension of the circular economy concept but focus on the environmental dimensions (Korhonen et al., 2018).

However, like any other emergent concept, there are always barriers associated with it as it evolves (Friant et al., 2020). Because the concept is still in its infancy and has yet to reach maturity, defining it entirely has become a challenge. Various scholars have further argued that the concept is vague and unclear (Murray et al., 2017; Kirchherr et al., 2017; Korhonen et al., 2018; Korhonen et al., 2018a).

Hence, the association circular economy concept with recycling and environmentally friendly products. And the departure from the inclusive definition circular economy. In order to gain a broader perspective and understanding of the circular economy concept, it is essential to close the gap between theory and practice (Barreiro-Gen & Lozano, 2020).

Based on these findings, there is still a perception that the circular economy is a niche topic that lacks governance. It is viewed as a niche concept open to multiple interpretations, creating further confusion for those trying to understand what the circular economy means. Additionally, it contributes to a lack of adoption of circular economy interventions.

6.4.1.3. Environmental Barriers

It has been established that the primary barriers to implementing a circular economy are related to the stakeholder dimension of the STS framework. These barriers include financial /economic circumstances, regulatory frameworks and stakeholder dimensions. Barriers related to regulatory frameworks and financial/economic circumstances followed closely behind. This section will discuss the findings for each barrier, as highlighted in chapter five.

a) **Stakeholders**

The study identified five barriers to implementing circular economy interventions. These barriers included Negative customer attitudes, Lack of customer awareness, Misalignment between industry stakeholders, and Lack of government support. These findings from each barrier will be discussed in the following sections.

i. Lack of customer awareness

Participants highlighted the need for more awareness by the customers as another barrier to implementing circular economy interventions. Further, participants argued a need to educate consumers on their role in the recycling process and the ecological impact of products to increase their understanding and awareness.

In this context, Govindan and Bouzon (2018) argued that consumers' environmental awareness and stricter government policies are the drivers of the industry to explore alternative value-creation processes.

As de Jesus and Mendonça (2018) asserted, for the circular economy products and service market to exist, consumers need to be willing to change their consumption patterns. Thus willing to embrace remanufactured products and circular economy services.

Thus, consumers' lack of awareness will lead to the non-acceptability of circular economy products and services (Patwa et al., 2021; Sharma et al., 2021). Furthermore, due to a lack of interest in such products, the market availability of such products is adversely affected (Sharma et al., 2021).

As such, Kirchherr et al. (2018) concluded that a lack of customer awareness is considered the main barrier for businesses and policymakers. Thus, also a barrier for SMMEs intending to implement circular economy interventions.

This barrier, however, does not seem to be fully supported in the context of this study. In this case, participants highlighted the lack of customer awareness in the context of recycling and the environmental impacts of the products. Therefore, focusing on interventions that address environmental issues or material circulation.

ii. Lack of government support

The government plays a vital role in creating an enabling environment for the manufacturing sector to implement circular economy interventions. In this context, the study established that the government needs to provide more support for SMMEs to implement circular economy interventions. Therefore, highlighting the significant role the

government has in adopting circular economy interventions (Govindan & Hasangic, 2018).

Further, the government has multiple roles to play. Thus, through policy framework government can address systems barriers (Hopkinson et al., 2018) to implementing circular economy interventions.

However, the government's lack of synergy and coordination hinders SMMEs from implementing circular economy strategies. In this context, Kirchherr et al. (2018) concluded that a lack of synergy within the government hinders that transition to a circular economy.

Further, the government can improve customer awareness through consistent promotion (Sajjad et al., 2020) and provide financial and technical support (Alonso-Almeida et al., 2021) to catalyse SMMEs to adopt circular economy intervention. However, in the absence of government interest and leadership (Sajjad et al., 2020), SMMEs are likely to fail in implementing circular economy interventions.

There is enough evidence to support the current literature's argument that the government should create an environment encouraging SMMEs to adopt a circular economy. As a result, the government has not coordinated and enforced regulations and policies.

iii. Non Acceptance of CE products and Services

The dominant theme under this barrier has been the customers' negative attitudes and closed mindsets, which leads to the non-acceptance of circular economy products and services. Thus, the perception is that products manufactured from recycled materials are inferior. In this context, consumer preferences and behaviour remain significant factors for adopting circular economy interventions (Patwa et al., 2021; Sharma et al., 2021).

According to Jaiswal and Kant (2018), consumers' green purchase intentions are primarily driven by attitudes toward green products and environmental concerns. As such, Kumar et al. (2021) concluded that consumers buy green products to protect the environment. In this context, Dhir et al. (2021) concluded that environmental attitude, among other factors, is a positive predictor of green apparel buying behaviour.

As such, consumers lack awareness and interest in recycled goods and the impacts of circular economy, this creates market uncertainty and quality concerns for consumers (Sharma et al., 2021). Further, consumers must contend with counterfeiting and product authenticity as potential risks associated with second-hand products (Jain et al., 2022).

Further, consumers must contend with the product aesthetics and greenwashing concerns on some products, such as second-hand apparel (Rausch & Kopplin, 2021). Thus, negatively impacting the consumer's purchase decisions.

In addition, this creates another barrier for consumers when making a purchase decision. Therefore, resulting in a reluctance to switch to products made of recycled materials (de Jesus & Mendonça, 2018) and a lack of acceptance of products made from recycled materials (Patwa et al., 2021).

In this context, these findings reinforce the current discourse that the lack of acceptance of circular goods and services is a barrier that prevents SMMEs from implementing circular economy interventions within their organisations.

iv. Misalignment between industry stakeholders

Participants asserted that waste management processes need to be better coordinated. In this regard, lack of collaboration between the actors has been cited as a hindrance to implementing circular economy interventions. Therefore, creating a challenge for SMMEs to implement circular economy principles.

Thus, consideration should be given to the complex process of adopting and implementing circular economy interventions. In this context, the process requires the involvement of multiple actors (Dey et al., 2020; Patwa et al., 2021; Sohal et al., 2022) to share service and co-create value in the value chain (de Jesus & Mendonça, 2018; Friant et al., 2020).

Thus, for the transition to a circular economy to be achieved, it would be necessary for all stakeholders in the ecosystem to work together (Barreiro-Gen & Lozano, 2020; Nudurupati et al., 2022). In this context, the notion of individualistic actors working in isolation without another stakeholder would create tension between actors. In particular,

those actors that are losing market share due to the implementation of circular economy interventions.

As such, for SMMEs to successfully implement circular economy interventions would require greater collaboration between multiple actors and stakeholders (Barreiro-Gen & Lozano, 2020; Sohal et al. (2022). There was not a lot of evidence to support this finding in the literature. A considerable amount of literature focuses on collaborations but not on synergies between stakeholders.

b) Regulatory Frameworks

i. Institutional barriers (Policy Frameworks and Implementation)

The study identified Institutional barriers (Policy Frameworks and Implementation) as one of the barriers within the regulatory framework's dimensions of the STS framework. Participants argued difficulties with red tape for product approval due to multiple regulations and a lack of policy direction due to the slow pace of policy implementation as the factors hampering the implementation of circular economy intervention.

In this context, the government has a role in implementing circular economy interventions through policy formulation and implementation thereof. As de Jesus and Mendonça (2018) asserted, the double role of policy indirectly triggers undesired consequences. As such, the policies can trigger a positive or negative reaction by SMMEs. In this case, policies with good intentions may receive a negative response from the business sector.

Further, the government has the maximum impact on implementing circular economy in the supply chain (Govindan & Hasanagic, 2018). However, the lack of synergy within the government departments decelerates the transition to circular economy (van Keulen & Kirchherr, 2020).

This lack of synergy and cohesion in government thinking would lead to inconsistent government policies, therefore, a barrier for SMMEs to adopt circular economy interventions. For example, institutional barriers are causal factors to cultural barriers, such as lack of o consumer awareness and interest (Kirchherr et al., 2018) and market and technological barriers (Grafström & Aasma, 2021).

In this context, the institutional barriers determine the enabling environment for SMMEs to implement circular economy interventions. In light of this, the current literature supports the conclusion that red tape caused by multiple regulations or their absence is a barrier that needs to be addressed. Therefore, the findings are consistent with what is currently known in the literature.

c) Financial/Economic Circumstances

i. Lack of Access to Funding

Access to funding is one of the main barriers impeding SMMEs within the manufacturing sector from implementing circular economy principles. Thus, asserting that funding is required to access the respective technologies and equipment necessary to transition to a circular economy. Economy requirements. Therefore making circular initiatives expensive to implement (Kirchherr et al., 2018)

As a result, SMMEs are already experiencing financial constraints that make it difficult for them to make the initial capital expenditure required to implement circular economy (García-Quevedo et al., 2020; Journeault et al., 2021; Marrucci et al., 2021; Sohal et al., 2022; Sharma et al., 2021).

Thus, according to Malik et al. (2022), SMMEs cannot implement circular economy interventions without financial support. Furthermore, according to García-Quevedo et al. (2020), most organisations have acknowledged this as one of the key barriers to implementing circular economy interventions.

Further, circular economy is seen as experimental; sufficient funding is required for research and development. However, with the SMMEs not having internal capabilities for research and development, the funding required to access research institutions could be a barrier for these SMMEs (Marrucci et al., 2022).

In addition, the perception that circular economy is emergent presents a unique challenge and financial risk for traditional investors (Austin & Rahman, 2022). Thus, it makes traditional investors reluctant to invest in circular economy interventions and pushes SMMEs into a position where they cannot access the necessary funding.

Therefore, according to Austin and Rahman (2022), funding is critical to encourage SMMEs to adopt and implement circular economy interventions.

According to Ghisetti and Montresor (2020) and Jinru et al. (2022), addressing this hurdle may require alternative funding sources. Alternative funding sources include government incentives and grants (Alonso-Almeida et al., 2021). However, support mainly depends on the government regulatory framework (Malik et al., 2022; Moktadir et al., 2020; Virmani et al., 2020). Thus, the policy framework that supports tax reduction and benefits, incentives and grants enable the successful implementation of circular economy interventions.

Although there was the realisation that the circular economy is experimental and that access to funding is required to acquire the necessary technology, there was not much evidence to suggest that lack of access to funding is a significant barrier.

6.4.2. Factors Enabling Implementing of Circular economy interventions

6.4.2.1. Social Factors

a) **Goal Dimension**

i. **Management Commitment**

The study's results have demonstrated that management commitment is one of the social factors within the cultural dimension that can help SMMEs implement circular economy initiatives more effectively. In this regard, participants in the survey asserted that the circular economy should be integrated into the organisation's values and vision at all levels.

Thus, to facilitate the transition to a circular economy, top managers must adopt circular economy into their strategies and document it in their organisational policies (Agarwal et al., 2018). Therefore, creating an organisational culture that supports circular economy and fosters employee commitment towards implementing circular economy interventions (Betrasini et al., 2021; Kitsis & Chen, 2021). For this reason, the organisation needs to implement circular economy interventions as a focal point of its efforts.

In this context, top managers are responsible for formulating unified strategies (Betrasini et al., 2021; Kitsis & Chen, 2021) and aligning these strategies with organisational objectives. Further, top managers are responsible for allocating necessary resources and mediating stakeholder pressure along the value chain (Centobelli et al., 2021). Therefore, enabling SMMEs to implement circular economy interventions at an operational level (Sarja et al., 2021),

Sohal and De Vass (2022) asserted that top management passions and visions are antecedences for adopting and implementing circular economy interventions. On the other hand, Kirchherr et al. (2018) asserted that weakness of management visions and hesitant organisational culture are potential barriers to implementing of circular economy.

According to Yamoah et al. (2022), top management commitment can shape the organisation's responsiveness or inaction towards a circular economy. Thus, without the top manager's commitment, implementing the circular economy interventions will likely be unsuccessful (Kitsis & Chen, 2021; Sharma et al., 2021; Wijethilake & Lama, 2019).

The assertion that a circular economy should be integrated with organisational strategy, vision, and culture is well supported by extensive literature. Therefore, the findings add to the current understanding of the role of management commitment as an enabler of implementing circular economy interventions.

b) People Dimension

i. Capacity Building (Training)

SMMEs not affiliated with CE-related organisations identified capacity building (training) as one of the critical enablers to implementing circular economy interventions. In addition, it highlighted the need to build relevant skills specific to the industry to enable SMMEs to adopt circular economy interventions. Moreover, participants further highlighted the importance of mentoring as one of the possible mechanisms beyond the formal education systems.

As highlighted above, lack of knowledge and access to expertise has been identified as barriers to implementing a circular economy. Therefore, facilitating SMMEs to implement circular economy interventions would require them to reevaluate their core competencies and have access to relevant capabilities (expertise) (Kuhlmann et al., 2022).

As such, the need to develop and train employees or the broader training to produce skills relevant to the industry. Accordingly, SMMEs must embark on training (Sharma et al., 2018) or knowledge exchange (Prieto-Sandoval et al., 2019).

In this context, the broader education system and mentoring facilitate training knowledge exchange and build the necessary competencies (Prieto-Sandoval et al., 2019; Sohal et al., 2022). Further, SMMEs can also consider other external sources of knowledge to build such competencies and capabilities (Prieto-Sandoval et al., 2019).

As Yamoah et al. (2020) asserted, circularity education and training change the negative perception and encourages managers' engagement with relevant stakeholders to create synergy and strategies that promote the implementation of circular economy interventions.

Thus, suggesting that training should not only be limited to general employees but also include executives. In this context, broadening the executives' knowledge (SMMEs owners) will change their perception of the circular economy. Thus, supporting the current discourse on training as an enabler for SME implementation of circular economy interventions. In this context, the transition to a circular economy requires new skills.

6.4.2.2. Technical Factors

a) **Knowledge Dimension**

i. **Understanding of the Circular Economy Concept**

Most participants have emphasised the need for knowledge and understanding of the circular economy as an enabler towards the implementation of the circular economy. Other participants highlighted the need for more research, workshops, and mentoring to acquire such knowledge.

According to Hofmann and Jaeger-Erben (2020), theoretical and practical knowledge is essential for organisations to transition to circular economy practice. At the same time, Sharma et al. (2019) assert that a lack of technical knowledge on recycling inhibits SMMEs from recycling their byproducts and materials.

As a result, SMMEs have been reluctant to adopt circular economy interventions due to a lack of knowledge about how to configure the circular economy (Centobelli et al., 2020) and how to integrate it into their business models (Marucci et al., 2021).

As asserted by de Jesus and Mendonça (2018), the transition to a circular business model (for example, product life extension) requires businesses to have in-depth knowledge about the enhancements and optimisations to be made on the product to deliver the value proposition.

Therefore, it highlights an essential aspect of circular economy: the importance of knowledge as a factor in the transition to circular economy. Furthermore, some empirical studies have pronounced knowledge of circular economy practices as one of the critical success factors in implementing circular economy interventions (Moktadir et al., 2020).

Therefore, overcoming these hurdles would require SMMEs to acquire relevant knowledge through external sources to facilitate the transition to a circular economy (Marucci et al., 2021; Prieto-Sandoval et al., 2019).

Further, the acquired knowledge would support managers and owners to understand better what capabilities, competencies and resources are required to reconfigure the existing business models into business models (Prieto-Sandoval et al., 2019).

Understanding the circular economy concept as an enabler for SMMEs to implement the circular economy strengthens the current discourse on the role of knowledge in the circular economy.

b) Process Dimensions

i. Operational Benefits

With circular economy offering an opportunity to exploit alternative raw materials, participants highlighted operational benefits as one of the factors in implementing circular economy interventions.

Participants asserted that recycled materials could be used together with virgin materials in this context. Thus, using recycled materials contributes to reducing consumption and dependency on natural resources (Nudurupati et al., 2022). Therefore, asserting a potential cost saving by exploring alternative raw materials.

In this case, it reduces the consumption of raw natural resources (Dey et al., 2020) and the associated costs (Govindan & Hasanagic, 2018). Therefore, deriving financial benefit from resource provision and utilisation (Ormazabal et al., 2018) by reducing the consumption of natural resources. It is thus possible to reduce costs by reusing and recycling materials to reduce waste (Nudurupati et al., 2022).

Further, participants asserted that byproducts or waste from their operations could be reclaimed and recycled into their production processes instead of disposing of these byproducts into the environment. While other SMMEs only use recycled materials as input materials in their production processes.

Thus, taking advantage of the relatively cheap recycled materials and generating cost savings through waste minimisation (Tura et al., 2019) while avoiding additional transport and labour costs of waste disposal.

As demonstrated above, sufficient literature suggests that SMMEs and other organisations transition to a circular economy because of the operational benefits associated with reduced materials inefficiencies. Thus, this finding advances the current circular economy discourse.

ii. Availability of Feedstock

Availability and access to feedstock are essential for every business to run its operations. As such, SMMEs have identified the proximity of the feedstock as one of the factors enabling factors to implement circular economy interventions. Further, participants argued, the proximity determines ancillary operational costs such as transportation, which otherwise get passed to the consumers.

As asserted by Govindan and Hasanagic (2018), as the product life extends, there is a potential to reduce the availability of recycled materials. In addition, the secondary processing costs (collection, sorting and processing costs) may also contribute to the no availability of recycled materials (Paletta et al., 2019).

These are some of the challenges that the sectors need to address to ensure the availability of suitable recycled materials. SMMEs need the technical know-how (Sharma et al., 2021) and the necessary technology. In addition, the sector has to contend with volume uncertainty and market volatility due to an irregular supply of recycled materials (Paletta et al., 2018).

Therefore, creating a competition between the use of virgin materials and recycled materials. Thus, creating undesirable dependency paths for the sustainability vantage point (Govindan & Hasnagic, 2018).

In this context, the availability of feedstock plays a vital role in adopting circular economy interventions. As such, the manufacturing sector primarily operates through 4R strategies (reduce, reuse, recycle and remanufacture), and with feedstock availability, these interventions may materialise.

Moktadir et al. (2020) assert that these interventions encourage sustainable usage of natural resources. Thus, waste materials can be used as an alternative for manufacturing or generating the energy required to sustain production processes.

Therefore, with the non-availability of alternative raw materials (Recycled, reclaimed), SMMEs have no option but to continue to use natural resources for their production processes (Govindan & Hasanagic, 2018; Kirchherr et al., 2018).

The primary goal of the circular economy is to reduce natural resource consumption. Literature assumes that recycled materials are readily available and easily accessible. However, in the context of this study, although not supported by literature, the proximity of these resources could drive SMMEs to implement circular economy interventions.

6.4.2.3. Environmental Factors

a) **Regulatory Frameworks**

i. **Institutional pressure**

To achieve their sustainable development goals and a net-zero carbon economy, many governments are pushing circular economy policies. Thus, it highlights the role of institutional pressure as a potential driver in implementing circular economy strategies.

In this context, participants asserted that government policies put pressure on corporates. In turn, these corporates pressure SMMEs to implement circular economy interventions. Thus, indirect pressure on SMMEs to adopt circular economy interventions.

In this context, the circular economy has gained prominence and has been assimilated into countries and strategic conversations on sustainability (Ciliberto et al., 2021). As such, countries have developed regulatory frameworks incorporating elements of circular economy.

For example, the National Environmental Management Act No. 107 of 1998 make a provision for waste management. Thus, making it mandatory for organisations to comply with the requirements of these regulations.

Thus, government policy frameworks can influence organisations' strategic direction to implement circular economy interventions (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018). Similarly, stricter regulations can achieve the same (Govindan & Bouzon, 2018).

On the contrary, other empirical evidence suggests that the regulatory pillar alone is insufficient to get organisations to transition to a circular economy (Renta et al., 2018).

Thus, this indicates that sometimes government policies indirectly lead to inadvertent outcomes (de Jesus & Mendonça, 2018). In this context, the policy frameworks can be a driver or a barrier to SMMEs adopting circular economy interventions.

Direct pressure from the government through legislation has been well-documented in the literature. Thus, the finding advances current discourse on the role of the government as an institution in implementing circular economy interventions.

b) Stakeholders

i. Government Support

Although the government offers some financial support in the form of grants, in general, the current financial support is inadequate to cover the full scope of the project. As such, participants have argued that government should consider developing and implementing policies that incentivise SMMEs and provide rebates for SMMEs that adopt circular economy interventions. Moreover, policies that focus on developing the manufacturing sectors rather than promoting imports of manufactured goods and services.

In this context, participants highlighted the role of the government in creating an enabling environment that supports SMMEs to implement circular economy interventions. Further, the government has a role in ensuring the manufacturing sectors' development rather than focusing on importing goods.

Therefore, requiring government-private sector collaboration to assert economic growth and transition to a circular economy (Hopkinson et al., 2018) and create general awareness about circular economy benefits and risks at a societal and industry level (Malik et al., 2022). Thus, the government must formulate policies and programs that enable SMMEs to implement circular economy interventions (Virmani et al., 2022).

Thus, through policies, the government can introduce reforms in the financial sector that can unlock the necessary investments (Sharma et al., 2022) and provide further subsidies (Kirchherr et al., 2018) to SMMEs in need of such funding.

In addition, the government can offer incentives, tax rebates (Malik et al., 2022; Virmani et al., 2022) and grants (Moktadir et al., 2020) to SMMEs that have implemented or

intend to implement circular economy interventions. Thus, providing financial support (Alonso-Almeida et al., 2021) and alleviating the financial barriers for SMMEs intending to implement circular economy interventions.

SMMEs face internal financial barriers and find it challenging to access finance. Therefore, the government can provide research and development grants to SMMEs to help them overcome these hurdles (Moktadir et al., 2020). Furthermore, through the knowledge generated, government institutions can offer technical support (Alonso-Almeida et al., 2021). Thus supporting SMMEs build the necessary capabilities required to reconfigure their operations in line with the circular economy principles.

As such, the government's role is not only limited to financial and technical support. In addition, the government can facilitate stakeholder networks to enhance the adoption of circular economy (Journeault et al., 2022).

Through these stakeholders' networks, SMMEs can create complementary collaboration to address other barriers to implementing circular economy interventions. For example, knowledge barriers through collaborating with academic institutions (Prieto-Sandoval et al., 2019; Sohal et al., 2022).

In this context, an indication of the broader role of government support in enabling SMMEs to address multiple barriers to implementing circular economy interventions. This finding contributes to the current literature that government support is a crucial enabler for SMMEs to adopt circular economy interventions.

ii. Customer Awareness and Pressure

Participants generally identified customer awareness and pressure as other factors that could drive the implementation of circular economy interventions. Further, participants argued that the increased awareness of customers, in particular Gen-Z, will lead to improvements in SMMEs implementing circular economy interventions.

Further, corporate customers are putting pressure on SMMEs to reconfigure their operations to comply with regulatory requirements. Therefore, cascading the requirements and SMMEs required to show initiatives towards implementing circular economy interventions.

In this context, Mostaghel and Chirumalla (2021) concluded that customers' awareness, perceived value and attitudes significantly influence ethical purchase intention. While Govindan and Bouzon (2018) assert that customers increased environmental awareness impacts organisations to adopt circular economy interventions. Thus, asserting a positive role in customers' awareness of the implementation of circular economy interventions.

According to Wang et al. (2020) customers' perceptions of products' history (recapture and remanufacture processes) positively influenced their switching intentions. Thus, asserting that increased customer awareness informs the customer's purchase intentions (Govindan & Bouzon, 2018; Mostaghel & Chirumalla, 2021; Wang et al., 2020).

In this context, customers want to feel that they are contributing to finding solutions to the current environmental challenges (Kumar et al., 2021). Further, customers may prefer companies with an excellent social and environmental reputation (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018).

Thus, these circular economy principles must be embedded in the value chain according to customer needs (Wang et al., 2020). Consequently, driving SMMEs to implement circular economy interventions to retain and access new customer segments.

This pressure is exerted mainly by corporates on SMMEs in response to institutional pressure. Thus, providing sufficient evidence to support the current discourse that customer awareness and pressure (business-to-business) are the critical drivers for SMMEs to adopt circular economy interventions.

iii. Sharing best practices

Most participants identified sharing best practices as another factor that could enable SMMEs to implement circular economy interventions. For example, participants asserted that international corporations have been sharing knowledge and best practices with local SMMEs from the industry in supporting the SMMEs to implement circular economy interventions. Similarly, participants highlighted Industry bodies (formal or informal) as another platform for sharing knowledge and best practices.

As such, the transition to a circular economy is complex and requires collaboration with multiple stakeholders for successful implementation. However, according to Centobelli et al. (2020) and Marrucci et al. (2021), there needs to be more literature on the successful implementation of circular interventions.

Organisations may only implement a circular economy if they know whether it is circular (Prieto-Sandoval et al., 2018a). Therefore, it is essential to emphasise the need to share best practices between SMMEs to transfer knowledge and support each other to overcome the challenges and barriers associated with these small-sized businesses.

In this context, SMMEs implementing circular economy interventions such as waste minimisation can share such experiences. According to Katz-Gerro and López Sintas (2019), these experiences may boost the implementation of circular economy by SMMEs.

This provides SMME owners with the necessary experience to convince themselves about the benefits circular economy and knowledge to develop the necessary capabilities for implementing circular economy interventions (Katz-Gerro & López Sintas, 2019). In this case, SMME owners can determine the starting point (waste minimisation) and gain experience before adding other complex circular economy interventions.

As such, Marrucci et al. (2021) identified knowledge sharing and the value of externally generated knowledge as some of the antecedences to developing a circular economy intervention for SMMEs. This context emphasises the value of learning from and with other stakeholders.

In this context, the findings suggest that through information-sharing sessions, SMMEs can benefit from the best practices, which, in turn, will help that deal with the lack of barriers to implementing circular economy interventions.

Therefore, this advances the discourse in the current body of literature, which suggests that sharing best practices is one mechanism SMMEs could learn from those that have previously implemented circular economy interventions (Katz-Gerro & López Sintas, 2019; Marrucci et al., 2021).

iv. Ecological Concerns

Another factor raised by participants influencing the implementation of the circular economy business interventions was ecological concerns. These factors include the impacts of global warming and pollution and their impacts on climate change on farming, food security and health issues.

As Barreiro-Gen and Lozano (2020) asserted, the circular economy has gained prominence as one of the approaches to tackling environmental sustainability. In this context, the circular economy assimilates environmental sustainability through environmental practices and reversed physical flow concepts (Korhonen et al., 2018; Prieto-Sandoval et al., 2019).

Thus, promoting strategies that focus on reducing, reusing, recycling (Kalmykova et al., 2018; Korhonen et al., 2018; Prieto-Sandoval et al., 2019) and redesigning (Sohal et al., 2022). From this perspective, circular economy is promoted by many governments as a top-down or bottom-up approach to address environmental and waste management challenges. Therefore, making compliance with these regulations mandatory for all organisations.

In this context, environmental regulation has been driving the organisation to explore alternative business models to address societal and environmental concerns (Govindan & Bouzon, 2018), resources consumption reduction and environmental preservation (Centobelli et al., 2020), and environmental restoration (Mehmood et al., 2021).

As such, Mehmood et al. (2021) concluded that environmental restoration, amongst other factors, is a driver for SMMEs with the agro-food supply chain to implement circular economy interventions. On the other hand, Mathivathanan et al. (2022) concluded that ecological factors drive the adoption of the circular economy (Mathivathanan et al., 2022). Further, it emphasises the role of environmental concerns in implementing circular economy.

Further, SMMEs have to contend with customers who prefer companies with excellent social and environmental reputations (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018). Therefore, it puts further pressure on SMMEs

to implement circular economy intervention to enhance their reputations (Sajjad et al., 2020).

As such, one of the primary reasons for circular economy interventions is environmental sustainability. Therefore, this finding supports and confirms the current literature that asserts that ecological concerns are possible drivers for SMMEs to implement circular economy interventions.

v. Stakeholders Collaborations

Given that SMMEs do not have access to funding, some participants have highlighted the need for partnership to gain access to financial support and relevant skills required for circular economy.

Further, participants highlighted the possibilities of gaining market access, investments and mentorships. In this way, SMMEs can fill the capability gaps by leveraging these collaborations. In this context, participants have argued for small enterprise development as one of the critical enablers for SMMEs to implement circular economy intervention.

Transitioning to a circular economy requires organisations to reconfigure their value-creation process. As previously highlighted in the section that explores the barriers to implementing circular economy strategies, SMMEs lack internal capabilities and are confronted with financial barriers (de Jesus & Mendonça, 2018; Govindan & Hasanagic, 2018).

From this perspective, Aarikka-Stenroos et al. (2022) asserted that organisations collaborate to fill the capabilities gaps within their organisations. As such, SMMEs are faced with financial constraints and are likely to collaborate with partners (stakeholders) that can provide financial support.

Therefore, aligning and finding synergies between other actors can provide the required capabilities (Aarikka-Stenroos et al., 2022). Thus, a complementary collaboration with a specific focus to address the capability gaps (Journeault et al., 2021).

Many large organisations struggle to integrate circular economy principles operations due to a lack of mandates and organisational inertia, amongst other factors (Veleva &

Bodkin, 2018). Therefore, by collaborating with SMMEs, corporates will support SMEs financially and benefit from making their procurement strategies sustainable (Sohal et al., 2022). Furthermore, this will allow SMMEs to implement circular economy interventions to fill the gaps and create links with the corporates (Veleva & Bodkin, 2018).

In this context, small enterprise development provides SMMEs with an opportunity to leverage funding and other capabilities (Technical Knowledge) while making economic gains. Thus, filling the capability gaps inhibiting SMMEs from implementing circular economy interventions (Aarikka-Stenroos et al., 2022).

Further, most notably, the participants highlighted that circular economy requires the involvement of multiple actors beyond the industry players and the government. As such, circular economy requires the involvement of all stakeholders, including society.

In this context, organisations do not exist as islands (Barriero-gen & Lozano, 2020). Thus, Fehrer and Wieland (2021) asserted that business is a large part of the societal and ecological systems. Therefore, a circular economy must also be implemented outside the organisation (Barriero-gen & Lozano, 2020).

Therefore, requiring better collaborations with relevant stakeholders beyond the organisational boundaries of circular economy efforts and activities (Barriero-gen & Lozano, 2020). As such, the concept has gathered interest from multiple stakeholders (businesses, governments, and policymakers), academics and practitioners (Bassi & Dias, 2020), and customers (Govindan & Bouzon, 2018).Therefore, these stakeholders also impact the successful implementation of the circular economy interventions (Barriero-gen & Lozano, 2020).

Thus, implementing the circular economy interventions requires the involvement of multiple stakeholders, as each has a different contribution. As such, this could benefit SMMEs and help them address potential challenges related to implementing circular economy interventions (Journeault et al., 2022).

Hence, this finding supports the current discourse that broader collaboration, including cross-sector partnerships, is necessary for SMMEs to implement circular economy initiatives successfully.

c) Financial/Economic Circumstances

i. Availability and Access to Funding

Further, participants highlighted the importance of funding. In general, availability and access to funding will support SMMEs in acquiring the necessary technology and equipment required to implement circular economy interventions.

As asserted by Austin and Rahman (2022), SMMEs are already faced with barriers such as lack of access to financing, low market demands, and lack of human and technology capabilities, hampering them from implementing Circular economy interventions. In this context, access to funding becomes critical for these SMMEs to fund the initial investment for transitioning to a circular economy (Austin & Rahman, 2022; Sharma et al., 2018).

In this context, participants argued the need to have access to both government and private funding as the biggest drawcard for SMMEs to implement circular economy interventions. According to García-Quevedo et al. (2020), the ability of the organisation to reconfigure its operations is linked to resources and capabilities. Thus, making the availability of financial resources a key enabler for SMMEs to adopt circular economy.

According to Moktadir et al. (2018), funding availability promotes the adoption of the circular economy. Thus, SMMEs can access and acquire the necessary capabilities to transition to a circular economy. As Mathivathanan et al. (2022) concluded, funding availability directly impacts the awareness of the circular economy and technological advancement.

With improved awareness and access to relevant technology, SMMEs can implement circular economy interventions. In this context, provisions must be made in the financing strategies for green manufacturing and sustainable goods (Jinru et al., 2022) to support SMMEs in implementing circular economy interventions.

In this context, the finding confirms the current discourse on the impact of access and funding availability towards implementing circular economy initiatives (Moktadir et al., 2018). Thus, reconfiguring operations and accessing the necessary skills and technology (Mathivathanan et al., 2022).

6.4.3. Factors Enabling Implementing of Circular Business Models

6.4.3.1. Social Factors

a) **People Dimension**

i. **Knowledge and skills**

For the adoption of circular economy business models, the population group identified skills and knowledge as one of the potential enabling factors for implementing circular business models. In this context, most participants asserted the diversity in the knowledge that different employees could bring into the organisation.

However, adopting a circular economy would require businesses to redesign their business models in line with circular economy practices (Centobelli et al., 2020; Nudurupati et al., 2022). Therefore, requiring organisations to have access to the relevant skills, expertise (García-Quevedo et al., 2020; Nudurupati et al., 2022; Sharma et al., 2022), and experience (Sharma et al., 2022). In addition, managers leading the transition should have the necessary organisational and managerial skills to support the transition (Chen et al., 2020).

According to Marrucci et al. (2021), human capital is a relevant factor for eco-innovation, and it has to be developed and managed. Thus, requiring employees with specific technical skills, expertise and cultural perspectives aligned to the circular economy practices (Marrucci et al., 2021).

In cases where these skills cannot be developed inside the organisations, thus, the organisation should, as an alternative, hire employees with relevant skills and capabilities. In this context, Marrucci et al. (2021) assert that the government provides funding for sustainability and innovation training for SMMEs to harness circular economy opportunities. In so doing, the support provided will go a long way in terms of the relevant skills required to foster the adoption of circular business models.

As such, Zhang et al. (2020) identified knowledge sources and experience as antecedence to the transition to circular economy, while Massaro et al. (2021) contend that knowledge transfer between academics and industry positively affects organisations

to pursue circular economy goals. In this context, there is an emphasis placed on knowledge and skills as an enabler of SMMEs adopting circular business models.

Overall, SMMEs lack human resources (García-Quevedo et al., 2020) and lack technologies, knowledge and information (Tura et al., 2019) that inhibit them from adopting circular business models.

Therefore having access to human resources with the necessary skills, expertise, and cultural orientation will positively impact SMMEs to overcome these hurdles. In this way, we can increase the chances of SMMEs adopting circular economy business models in the future.

In this context, the finding supports the current literature discourse that skills and knowledge are fundamental for successfully implementing circular economy initiatives (Marrucci et al., 2021).

6.4.3.2. Technical Factors

b) Process Dimension

i. Economic Gains- Profitability

Most participants identified economic and financial benefits as the primary driver for adopting circular business models. Participants have noted the operational benefits of reclaiming byproducts such as sand that would have otherwise disposed to the environment. Therefore, positively contributing to the socio-environmental challenges.

However, beyond these secondary benefits, the circular economy creates opportunities for SMMEs to benefit financially (Friant et al., 2020). According to Suchek et al. (2021), SMMEs may gain competitive advantages and create economic value by deploying circular business models.

In this context, the transition to circular business models would require innovative business models incorporating the circular economy principles for value creation. Thus reducing the dependency on natural resources and exploring alternative cheaper materials (Nudurupati et al., 2022).

According to Bocken and Ritala (2022), adopting closed–narrowing loops saves resources and costs. Thus, it is necessary to explore innovation within an organisation's boundaries to maximise profits. Furthermore, as asserted by Hu et al. (2021), green innovation generates product and process offsets, increasing better financial performance. This will support the financial gains that can be realised by adopting circular economy business models and interventions on a broad scale.

According to Chen et al. (2020), corporate profitability is essential for sustainability. In this context, SMMEs need to make profits in order to fund their circular economic initiatives. Thus, while de-coupling the economy from the environment and making social contributions, SMMEs should also benefit economically.

Thus, confirming the current discourse that there are potential economic benefits for the circular adoption economy. Beyond the socio-ecological benefits, there are also economic benefits for SMMEs (Chen et al., 2020). Therefore, financial and economic benefits drive SMMEs to adopt circular business models.

6.4.3.3. Environmental Factors

a) **Stakeholders**

i. **Socio-Ecological Benefits**

Participants highlighted the impact of climate change on social factors. In this context, participants highlighted the benefits of adopting circular business models to the environment and health issues. Further, participants highlighted the economic benefits associated with using recycled materials as raw materials in the production processes. Thus, alluding to reducing the amount of waste from the environment.

In addition to the environmental benefits, participants argued a potential revenue stream for the teams that are involved in recycling. In this context, some of the executives indicated that such revenue is used to incentives their employees. Thus, benefiting employees economically through the proceeds generated by considering circular business models.

In this context, there has been the realisation by consumers, governments and companies that circular business models offer economic and social prosperity while reducing the consumption of natural resources (Prieto-Sandoval et al., 2021).

Thus, de-coupling economic growth from resource consumption (Chen et al., 2020; Korhonen et al., 2018). Therefore, preserving the natural environment by reducing emissions and environmental footprint (Centobelli et al., 2020; Rosa et al., 2019).

As asserted by Rosa et al. (2019), these benefits provide the industry with a starting point and guide circularity. Hence, in this context, guiding SMMEs to choose the appropriate circular business models in line with their operations and the intended customer segments (Ferasso et al., 2021; Guldmann & Huulgaard, 2020; Mostaghel & Chirumulla, 2021).

Therefore, this finding support the current academic discourse on circular business models' role in achieving sustainability within the broader circular economy context.

ii. Government support

In this context, participants have highlighted the need for government to create an enabling environment that promotes circular economy principles. Creating the enabling environment will require the government to implement policies that promote circular economy principles.

In this context, the government must raise general awareness, develop new policies and directives, tax and financial incentives and support industrial ecosystems to adopt circular business models (Malik et al., 2022; Patwa et al., 2021; Yamoah et al., 2022).

However, beyond the abovementioned factors, the government can provide the necessary seeding investments, developing the platform for collaboration and cooperation, educational programs and the infrastructure required for sustainable development (Patwa et al., 2021).

Further, participants asserted the need for government to procure from SMMEs procure from as a mechanism to support and stimulate the manufacturing sector. Further, promoting procurement and buying of local products and services. In this context, Hofmann (2019) asserted that governments should consider preferential procurement

programs and funding of circular economy initiatives to enable SMMEs to adopt circular business models.

Thus, to encourage innovation, circular economy and new initiatives that promote sustainable consumption (Patwa et al., 2021), the government has a role in removing systemic barriers associated with the adoption and implementation of circular business models (Centobelli et al., 2020). Therefore, it encourages SMMEs to adopt circular business models.

The role of government as an enabler is well supported in the current academic discourse on the circular economy. As such, these findings support that government support could positively influence SMMEs to adopt circular economy models.

iii. Access to New Market Segments

Participants highlighted that adopting circular business models has expanded their markets to include other segments of the markets they would normally not consider. For example, the "rental" and "rent-to-buy" models for a company that designs and refurbishes electrical machinery has provided access to small mining houses that generally could not afford the equipment.

As such, the transition to circular economy necessitates organisations to rethink their business models to include circular economy practices (Centobelli et al., 2020; Manninen et al., 2018; Manninen et al., 2018). However, according to Tunn et al. (2019), these business models consider the value proposition and include the targeted customer segment whose problems are solved by these offerings (Ferasso et al., 2021).

Thus, incorporating circular services into the value-creation process, thus make the offering available to the targeted segment (Guldmann & Huulgaard, 2020). In this context, while developing these circular business models, SMMEs need to consider their intended market segments or adjust the value offering specifically to the targeted market segment (Mostaghel & Chirumulla, 2021).

In this context, the targeted customer segment can be integrated into the value-creation process (Tunn et al., 2019), thus co-creating value with the customers to better understand their behaviours and preferences (Mostaghel & Chirumulla, 2021).

Therefore, allowing customers to choose offers best suited to their preferences and personal needs (Tunn et al., 2019).

For organisations to successfully adopt circular business models, amongst other factors, they must balance the tensions between the value proposition and the customer segments and the changes that need to be made to achieve the transition (Mostaghel & Chirumulla, 2021).

Accordingly, there is a general acceptance that the role of the customer is crucial in the adoption and implementation of circular business models. Furthermore, a diverse number of circular business models can enable sustainable consumption by different customers segments (Tunn et al., 2019).

As such, this suggests that access to new market segments is a driver for SMMEs to adopt circular business models. However, this view is not well supported by the current literature on circular business models. In this context, literature realises the potential of gaining new market segments (Tunn et al., 2019).

6.5. Summary of factors enabling (inhibiting factors)

6.5.1. Barriers to the implementation of circular economy interventions

The study identified 11 barriers to implementing circular economy interventions. These barriers were across social and technical systems and the environment with which the socio-technical systems interact (Appendix 22).

As discussed in this chapter, SMMEs are battling social barriers in the current management values and are not inclined towards circular economy interventions. In addition, there needs to be more skilled human resources with relevant technical knowledge and understanding of the circular economy concept.

Further, these SMMEs are also faced with high implementation costs required as an initial investment for the implementation of circular economy initiatives. As such, the current policy frameworks are seen as a barrier in that they do not support SMMEs in their endeavours to implement a circular economy. Hence, lack of government support has also been cited as a barrier towards implementing circular economy interventions.

Further, due to a lack of government support, SMMEs need help to access the funding required for circular economy initiatives. Moreover, there is a lack of customer awareness, which leads to negative attitudes and a lack of acceptance of the circular economy products and services.

Although social and technical factors were also validated through literature, most of the barriers were in the environment in which SMMEs operate. In particular within the stakeholders' dimension. Furthermore, a range of barriers, such as funding problems, misaligned industry stakeholders, and a low level of customer awareness, were also encountered. It was found that participants did not provide sufficient evidence to support the existence of these barriers.

6.5.2. Factors enabling the implementation of circular economy interventions

Relying on academic literature and empirical evidence, factors were classified into enabling factors and driving factors towards implementing the circular economy interventions (Appendix 23). As such, driving factors are pressure points for SMMEs (for example, compliance), whereas enabling factors would get the respective SMMEs to comply with the respective standard or regulations.

In this context, the chapter has highlighted that SMMEs are likely to respond to external pressure from the government and customer pressure to address social and environmental concerns. Institutional pressure and customer awareness were validated as drivers for SMMEs to implement circular economy interventions.

Further, the chapter highlighted that SMMEs would likely implement circular economy initiatives for operational benefits. In this context, SMMEs can recycle their materials and optimise their efficiencies while benefiting the environment. Thus, responding to ecological concerns such as pollution.

These factors included stakeholders, regulatory frameworks and economic/financial circumstances. Thus, emphasising the need to collaborate with other relevant stakeholders to implement the circular economy interventions successfully. Further literature highlighted the government's dual role as a driver through policy frameworks and an enabler as a stakeholder in the transition process.

On the other hand, the chapter highlighted that for SMMEs to implement a circular economy successfully, it would require the commitment of top management. In this context, top management can allocate the necessary resources and collaborate with external stakeholders to acquire the technical knowledge and skills required to close the capability and competency gaps.

Further, through collaboration, management can access the necessary investments to fund circular economy interventions. However, this will require government support through policy formulation and implementation. In this context, all government departments must have synergy and cohesion.

In addition, the chapter revealed that stakeholders could have dual roles in that they can become enablers and drivers in implementing circular economy. Through stakeholder collaborations, SMMEs can close capability and competency gaps, thus enabling the implementation of circular economy interventions.

On the other hand, customers, as stakeholders, is a drivers for SMMEs to implement such circular economy initiatives.

However, there was a limited amount of evidence to support the availability and accessibility of recycled materials as a possible driving or enabling factor, despite other factors and enabling factors supported by the literature.

6.5.3. Factors enabling the adoption of circular business models

Relying on the literature, further analysis of the factors identified in Chapter 5 revealed that some identified factors are enablers. In contrast, others are drivers of adopting circular business models (Appendix 24).

SMMEs are driven by the need to access new market segments and economic gains while contributing positively to addressing the socio-ecological challenges. Thus, the realisation by SMMEs that the adoption of circular economy could address socio-ecological challenges while providing SMMEs with a new market of consumers who are conscious about the environment. However, there was insufficient evidence of access to new markets, but the realisation of a potential to access new market segments.

Although the factors identified cover both social and technical systems, again, the majority of the factors were within the environmental systems. In particular, the stakeholder dimension of the STS framework. Therefore, it emphasises the stakeholders' role in successfully adopting circular business models.

6.5. Conclusions

Relying on the socio-technical Systems theory, the study identified critical social, technical and environmental factors that could enable (inhibit) the implementation of circular economy interventions and circular business models.

Further, the chapter discussed factors that could enable (inhibit) SMMEs to adopt circular economy interventions and circular business models in line with the current academic literature. Thus, the literature highlighted in chapter two was used to validate enabling (inhibiting) factors as highlighted in chapter five.

In this context, the chapter established that some factors could be classified as enablers within the identified enabling factors. In contrast, others could be classified as drivers for implementing circular economy interventions.

In addition, the chapter highlighted that there needs to be more understanding of the circular economy concept. Thus, a reductionist approach is taken to define the concept with a significant emphasis on environmental considerations while excluding the possible social benefits of the circular economy.

Chapter Seven: Conclusions

The South African manufacturing sector is strategic in the country's economic recovery path and future development. Therefore, in line with the study objectives, the study undertook to identify and explain the main factors that could enable (inhibit) SMMEs to adopt circular economy practices/interventions and circular business models. Based on the study, the theoretical conclusions are presented in the section below.

7.1. Theoretical Principal Conclusions

Detailed conclusions for each research is discussed in the sections that follow below.

> **Research Sub-Question 1:** What factors could inhibit small, micro and medium enterprises within the South African manufacturing sector to adopt circular economy practices?

The study identified 11 barriers to implementing circular economy interventions. These barriers were within the social, technical and environmental systems of the socio-technical systems framework. These barriers offer insights into the internal and external barriers that SMMEs are battling with to implement circular economy interventions.

Analysis of these barriers reveal that internal to their organisations do not have the competence and the capabilities to implement circular economy. These competence and capability gaps are due to lack of access to human capital that has the relevant qualification (Marrucci et al., 2021) and the knowledge about circular economy concept (Kuhlmann et al., 2022).

This lack of knowledge and skills, does not only impact the skills but influences top managers inclination towards circular economy and consequently the culture of the organisations (Chowdhury et al., 2022). In this context, inhibiting manager to incorporate circular economy into their business strategies and fostering organisational culture that support transition to circular economy (Yamoah et al., 2022).

Further, SMMEs are also faced with technical systems barriers in that they do not possess the relevant knowledge about circular economy concept (Barreiro-Gen & Lozano, 2020) nor the technical knowledge on how to processes recycled material (Sharma et al., 2021).

Further, they still need to contend with the high cost of implementing such initiatives, while they are faced with internal resource (financial and human) constrains. As such, SMMEs cannot afford to transition their operations due to these associated high investment costs (García-Quevedo et al., 2020). Hence, a lack of adoption of circular economy interventions.

According, business is part of the socio-ecological system and does not exist in isolation. The findings suggest that most of the barriers the SMMEs are challenged with emanate for the environmental systems. These include, regulatory frameworks, stakeholders and economic/financial dimensions. However, stakeholder's barriers were predominant in this case.

As such, without government support through policy frameworks and implementation, SMMEs have to contend with institutional barriers and lack of policy direction from the government (van Keulen & Kirchherr, 2020). This creates a hostile environment for business to operate. In this context, SMMEs are already battling with lack of access to funding, misalignment between industry stakeholders and a lack of government support.

Although the study noted lack of access to funding, lack of customer awareness and misalignment between stakeholders as possible barriers, these were not well supported in terms of the evidence provided by participants.

Further, consumers and customers are not aware of the circular economy concept and this influence their purchase decision. In this context, consumers or customers not will to switch from products and services produced in a linear fashion to products produced in circular manner (de Jesus & Mendonça, 2018). However, there was insufficient evidence to support the lack of customer awareness as a barrier in the context of this study.

Linked to this hesitancy to switch are the negative attitude towards circular economy products (Patwa et al., 2021). Therefore limiting the market for such products and

services or creating competition between circular and linear produced goods and services (Korhonen et al, 2018).

In this context, SMMEs are faced with both intra- and inter-organization barriers to implementing circular economy intervention. Therefore, requiring SMMEs to have organization capacities and capabilities to foster the adoption of circular economy interventions.

However, the transition to circular economy also required the involvement of stakeholders. Therefore requiring SMMEs to balance the tension between intra- and inter-organisational factors.

> **Research Sub-Question 2:** What factors could enable small, micro and medium enterprises within the South African manufacturing sector to implement circular economy practices?

The study identified 11 factor which were classified in to driving and enabling factors for SMMEs to implement circular economy interventions. Overall, majority of the factors have been predominant in the environmental systems, with some of the factors within the social and the technical systems.

However, not all factors could be supported. For example, there was a lack of supporting evidence on the availability and accessibility of feedstock. In this context, there was an acknowledgement that poor-quality recycled materials could impact the adoption of circular economy initiatives (Paletta et al., 2019).

In the environmental dimension, majority of the factors were predominant within the stakeholder dimension with regulatory frameworks and financial /economic circumstances each having one factor respectively.

The domination of the factors in the stakeholder dimension offer interesting insights into the possible role of the stake holder as an enabler or a driver for SMMEs to implement circular economy interventions.

In this context, the study has established that stakeholder collaboration, sharing best practices are enabling factors for SMMEs to implement circular economy interventions, while customer awareness and the ecological concerns are drivers for SMMEs to

implement circular economy interventions.

This suggest a dual role that stakeholders can play in the transition to circular economy depending on whether the role is complementary or incompatible. In this context, complementary stakeholders can provide financial resources, skills and can offer advice to SMMEs intending to reconfigure their business models (Journeault et al., 2021).

In this case knowledge can be shared through sharing best practices or mentoring (Prieto-Sandoval et al., 2019; Sohal et al., 2022) or through collaboration with other instructions such as universities and research centers (Massaro et al., 2021). The enabling SMMEs to adopt circular economy interventions,

However, when the role of the stakeholders are incompatible, the stakeholder is likely to put pressure on the SMMEs to adopt the circular economy interventions. In this context, the role of government as an institution responsible for policy formulation and implementations.

Thus through the regulatory framework dimension, the government can implement policies that favour circular economy or through in action the government can hamper the adoption and implementation of circular economy Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018).

Therefore requiring the government to find the balance between these roles through the application of the policy framework. This further highlights the role of cross-sector collaborations to support SMMEs to implement circular economy interventions (Barreiro-gen & Lozano, 2020). These collaborations can be explores to improve access to finance, incentives, tax rebates for SMMEs struggling to gain access to inexpensive finance(García-Quevedo et al., 2020).

Similarly the same collaborations can be explored for value co-creation with the consumers and customers (Mostaghel & Chirumulla, 2021). In this case influencing the consumer/customers purchase intentions (Mostaghel & Chirumalla, 2021), and creating awareness about circular economy products and services (Govindan & Bouzon, 2018; Mostaghel & Chirumalla, 2021; Wang et al., 2020).

Further, for successful implementation of circular economy would require SMME owners to commit and document circular economy into their organisations purpose statement (Bertassini et al., 2021).

Thus making part of the future vision to enable them embrace circular economy to foster success full implementation (Sohal & De Vass,2022). This will enable top managers to allocate the resources or forge partnership that can address the address capability and competency holes.

After all, SMMEs stand to benefit economically through the implementation of circular economy interventions, while addressing the social and ecological concerns. Thus, a motivation of SMMEs to adopt and implement circular economy interventions.

Overall, for SMMEs to overcome the challenges and barriers to implementing circular economy, SMMEs owners must be willing to embrace circular economy and be open to collaborate with multiple stakeholders.

Therefore, to successfully implement circular economy, SMMEs should find a balance between the tension between the social and the technical systems and their interactions with the environment.

As such, some of these capabilities and competencies could not be developed inside the organisations (Marrucci et al., 2021), but, require collaboration with externs stakeholders (Journeault et al., 2021) to close the capabilities and competency gaps.

> **Research Sub-Question 3:** What factors could enable small, micro and medium enterprises within the South African manufacturing sector to implement circular economy business models?

Overall the study identified five main factors that could enable SMMEs to adopt circular economy business models. These factors cover both the social, technical and the environmental system of the STS framework with the majority of the factors within the environmental system. In this context, covering, people, process and stakeholders dimensions.

However, the majority of the factors (enablers or drivers) are concentrated under the stakeholder dimension. This suggests that SMMEs again have to contend with multiple stakeholders to overcome the hurdles associated with the adoption of circular economy interventions. This reinforces that notion that successful adoption of circular business

models require collaboration with multiple stakeholders beyond the organisational boundaries.

As such, the study could not find sufficient evidence that supports that access to new markets is a possible driver for SMMEs to adopt circular business models. However, there was a realisation that this could lead to access to new market segments (Tunn et al., 2019).

Apart from generating profits through adoption of circular business models, there is realization that SMMEs have to respond to customer needs to gain access to new market segments. Thus gaining competitive advantage over SMMEs that have not transposed their business models in line with the circular economy interventions (Mathivanathanan et al., 2022, Sucheck et al., 2021).

As such, with the improved awareness of the benefits circular economy, customer preferences change. In this case, customers' intentions or willingness to switch to circular products and services will be based on the need to contribute positively to the environment (Wang et al., 2020).

Further, customers may prefer suppliers with good social and environmental reputation. Therefore putting pressure on SMMEs to adopt circular business models and to incorporate those needs into their value proposition (Mostaghel & Chirumulla, 2021).

According to Centobelli et al. (2021), organisations are reluctant to adopt circular business models due to a lack of understanding of how to reconfigure and implement these business models. In this context, knowledge and skills are vital elements in supporting SMMEs to adopt and implementing a circular economy.

Thus, in the absence of the requisite knowledge and skills, SMMEs are likely struggle to adopt circular economy interventions without the necessary expertise and skill (García-Quevedo et al., 2020; Nudurupati et al., 2022; Sharma et al., 2022).

Although knowledge and skills were identified as enabling factor, it is interesting to note the role of government as an enabling factors to the adoption of circular business models. Government support has been a common theme between the implementation of circular interventions and the adoption of circular business models.

This suggest that government as a stakeholder is orchestrator in the adoption of the circular economy interventions. In this context, through policy implementation government can influence SMMEs to adopt and implement circular economy practices (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018).

Overall, to meet the needs of the new market segments and to response to socio-ecological challenges, SMMEs need to have the requisite knowledge about the respective circular business models. Further, they collaborate with consumers to understand their needs and preferences with regards to circular related products and goods.

However, the role of the government as the orchestrator remains ever crucial in the adoption of circular business models.

> **Principal Research Question**: What are the main factors enabling small, medium and micro enterprises to adopt the circular economy?

Overall, the transition to circular economy requires SMMEs to adopt circular business models and interventions in line with the circular economy principles. Although, the benefits of circular economy are known, SMMEs are faced with multiple hurdles that they need to overcome before they can adopt circular economy practices. In this context, barriers inhibit SMMEs to implement circular economy interventions and circular business models (Sub research questions one).

Therefore, SMMEs to adopt circular economy would require SMMEs to overcome the hurdles though possible enabling factors that could support the transition to circular economy (Sub Research question two and three). In this context, the study established that some of the enabling factors could be viewed as drivers (Table 5) while others as enabling factors (Table 6)

Table 5

Summary of the driving factors that could enable SMMEs to adopt circular economy practices/interventions and business models

Socio-technical systems	STS Dimension	Identified Factors	Classification
Technical	Process	Operational Benefits	Driver
		Economic gains - profitability	Driver
Environmental	Regulatory Frameworks	Institutional pressure (Government)	Driver
	Stakeholders	Customer Awareness and Pressure	Driver
		Socio-Ecological benefits	Driver
		Ecological Concerns	Driver

Note: Created by owner using data from Atlas.ti.22 software.

Therefore, as shown in Table 5 above, stakeholders are critical drivers for SMMEs to adopt and implement circular economy interventions. In this context, SMMEs need to respond to regulatory frameworks - Institutional pressure (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018) and stakeholder pressure through customer awareness (Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018) and the need to address ecological concerns (Centobelli et al., 2020; Govindan & Bouzon, 2018; Mehmood et al., 2021).

In the process, SMMEs could benefit economically through improved efficiencies through prolonged use of materials (Bocken & Ritala, 2022; Hu et al., 2021; Prieto-Sandoval et al., 2018; Tura et al., 2019). Thus, positively contributing to the social and environmental challenges. Therefore, gaining a competitive advantage (Nudurupati et al., 2022) over SMMEs that do not or do not intend to adopt circular economy principles.

On the other hand, the study established enabling factors to support SMMEs in overcoming hurdles and barriers to adopting a circular economy (Table 6).

Table 6

Summary of the main factors that could enable SMMEs to adopt circular economy practices/interventions and business models.

Socio-technical systems	STS Dimension	Identified Factors	Classification
Social	People	Capacity Building (Training)	Enabler
		Knowledge and Skills	Enabler
	Goals	Management Commitment	Enabler
Technical	Knowledge	Knowledge and Understanding of the CE Concept	Enabler
Environmental	Stakeholders	Sharing best Practices	Enabler
		Stakeholder Collaborations	Enabler
		Government support	Enabler
	Financial/Economic Factors	Availability and Access to Funding	Enabler

Note: Created by owner using data from Atlas.ti.22 software.

In this context, SMMEs owners need to be committed to circular economy. Thus, incorporate circular economy as part of their business strategy and document this in the company mission and purpose statement (Agarwal et al., 2018).

Further, this will allow top managers to align their company's strategies (Betrasini et al., 2021; Kitsis & Chen, 2021) with stakeholders' visions while fostering complementary collaborations (Journeault et al., 2021). In addition, this way, SMMEs can access the revenant skills, funds and other technical skills (Marrucci et al., 2021) required to close the competency and capability gaps (Journeault et al., 2021). Moreover, they can fund their circular economy initiatives through access to finance.

However, beyond the social and technical systems, SMMEs must collaborate with external stakeholders to ensure adequate support. Most importantly, the cross-sector collaboration with all stakeholders across the value chain (including government) to address the challenges faced by SMMEs towards the adoption of circular economy practices (Barriero-gen & Lozano, 2020; Prieto-Sandoval, 2019).

The government, as the orchestrator, can formulate and implement policies that favour circular economy (de Jesus & Mendonça, 2018). However, this means that government should balance the tension between its multiple roles.

Therefore, the study highlights the need for government to create an enabling environment that could foster collaboration and cohesion among all relevant stakeholders in the ecosystem. Consequently, the government must formulate and implement policies to balance the tension between its responsibilities.

7.2. Proposed Conceptual framework for adoption of circular economy

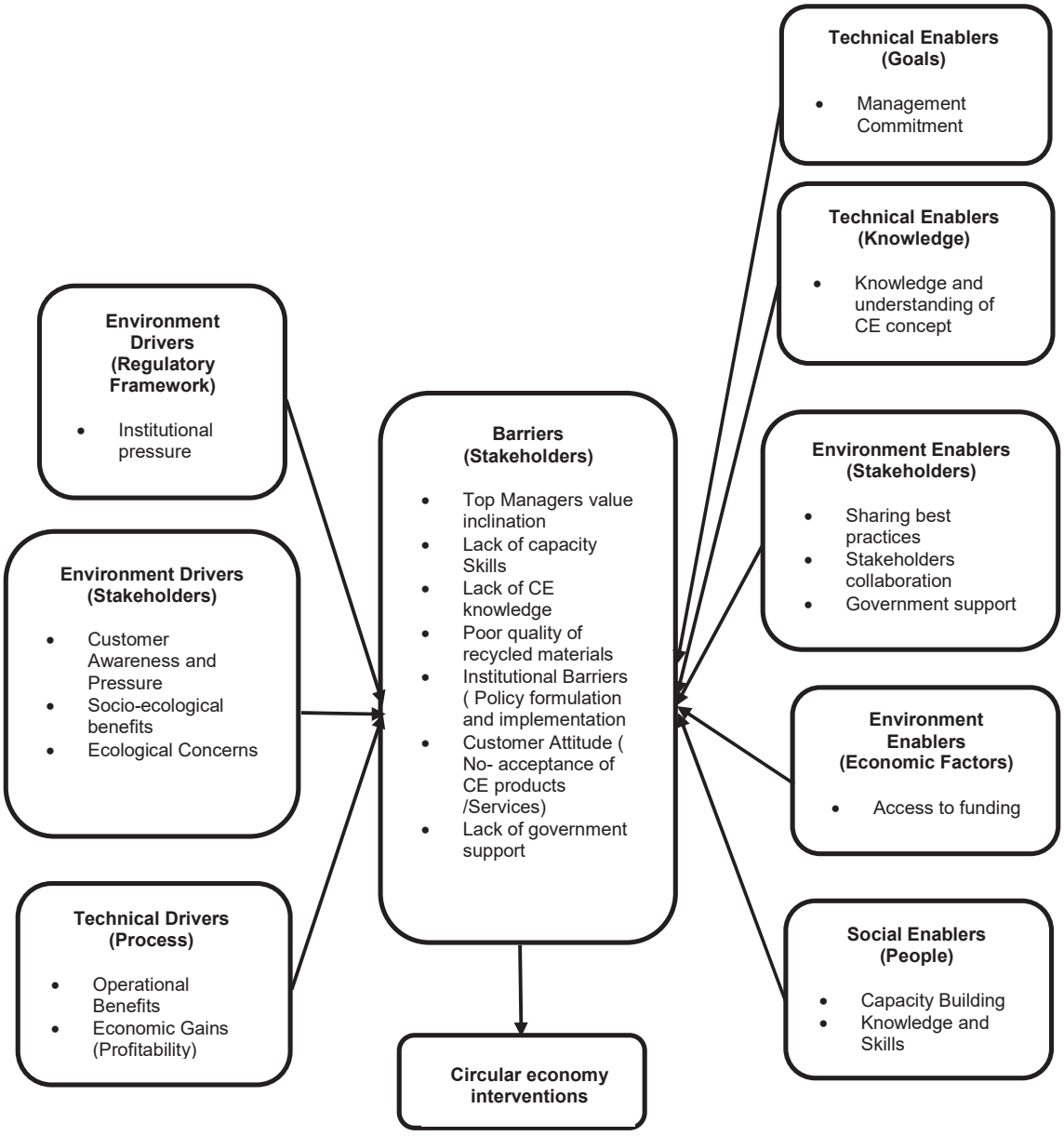
There is an inherent relationship between business and society. Thus, the transition to circular economy would require the involvement of all stakeholders and balancing the tension between social, environmental and economic aspects (Fehrer & Wieland, 2021). In this context, transitions ion to circular economy would require the involvement of all stakeholders in the ecosystems.

However, these businesses are socio-technical systems which interact with the environment. Therefore, conceptually transitioning to circular economy would require SMMEs to navigate social, technical and environmental issues (Sohal et al., 2022).

According to Sohal et al. (2022), SMMEs are willing to adopt circular economy practices. However, inhibiting the transition due to the associated barriers or partially implementing circular economy practices. In this context, (Figure 12) suggests that SMMEs need to explore collaborating with other stakeholders beyond the organisational boundaries (Barriero-gen & Lozano, 2020).

Figure 12

Conceptual model for adoption of circular economy interventions



Note: Created by the owner of the report."

7.3. Managerial and Government Implications

The study's findings have implications for both management and the government. From the STS framework, the organisation comprises the social and technical systems that interact with the business's environment.

In this context, the study established social, technical and environmental factors. However, the social and technical systems fall within management control.

Successful implementation of circular economy interventions will require managers to manage the interaction between the social and technical dimensions while mediating the environmental factors that could impact the overall transition to a circular economy.

Given the limited knowledge of the circular economy and lack of skills and knowledge, this would require managers to acquire the necessary competencies. Therefore, top managers must re-evaluate their core competencies and capabilities (Kuhlmann et al., 2022) to identify the new ones required for circular economy.

Therefore, requiring managers to allocate resources to develop such competencies (Sharma et al., 2018) or hire employees with the necessary qualification and experience (Prieto-Sandoval et al., 2019; Sohal et al., 2022). However, these initiatives would require the commitment of leadership and top managers (Bertassini et al., 2021; Marrucci et al., 2021).

To gain employee commitment, top managers should incorporate circular economy into the organisation's purpose and document it in the company policies. Thus, managers must design organisational structures and cultures that support innovation and circular economy principles (Bertassini et al., 2021).

For managers to make the necessary provisions for circular economy, circular economy should be incorporated into the business strategies (Kitsis & Chen,

2021). The transition process will be supported by getting top managers to commit to circular economy initiatives.

Thus, top managers can mediate the stakeholder pressure by aligning the stakeholders' visions with the circular economy vision of the organisation. Therefore, fostering collaborations with other stakeholders in the ecosystem.

The government has a central role in adopting circular economy intervention by creating an enabling environment to support the transition towards circular economy. Through policy framework and implementation, the government should balance the tensions in its multiple roles (enabler, barrier and enabler).

The circular economy is still emergent (Friant et al., 2020), with limited examples of successfully implemented initiatives. Therefore, making circular economy experimentation with limited information on commercial success. As such, many traditional financial institutions are concerned about the associated financial risks (Austin & Rahman, 2022).

Therefore, the government must be a developmental state by funding innovation initiatives through research and development grants explicitly advancing circular economy practices (Mokatdir et al., 2020).

Hence, encouraging collaboration between the industry, academic institutions, and research centres (Prieto-Sandoval et al., 2019; Sohal et al., 2022). Further, helping to bridge the competency gaps and build the required capabilities.

In addition, the government should reform their policies to promote access to private and government funding, including grants (Moktadir et al., 2020). The policy reforms should also consider programs for tax rebates and incentives for organisations with the intention to or have adopted a circular economy (Malik et al., 2022; Virmani et al., 2020). Therefore, alleviating the challenges associated with a lack of access to funding and the cost of implementation. he

The findings further highlighted limited knowledge of the circular economy concept and its implementation. Moreover, current government policies focus more on managing environmental risks (Gilberto et al., 2021) from the dominant linear economy.

In this context, the government should consider policy reforms in the education system to ensure that the circular economy is incorporated into the school curriculum. Thus, creating the necessary awareness and educating future consumers about the risks of not and benefits of implementing a circular economy.

From the systems perspective, implementing the circular economy intervention is a complex process with multiple interactions. Thus, the transition to a circular economy would require the involvement of multiple actors within the value chain, inside and beyond the organisational boundaries (Barriero-gen & Lozano, 2020; Prieto-Sandoval, 2019).

Thus, the transition to a circular economy would require stakeholders' coordination at the micro, meso and macro levels. Although a business can provide leadership in the transition process, the responsibility must be addressed by the business. Therefore, collaboration is required across all levels, including society, government, industry, consumers and non-governmental bodies.

7.4. Theoretical Contributions

The circular economy concept has received growing global attention as an alternative to linear economy models. However, there has been a great emphasis on understanding barriers and drivers that influence organisations to adopt circular economy practices. Thus, it opens a gap to explore factors that can enable organisations in developing countries to adopt circular economy practices and adapt their business models from the dominant linear economy models.

The study contributes to advancing the academic discourse on adopting circular economy practices in emerging markets and the circular economy in the following manner.

The study has established that there is limited knowledge and understanding of the circular economy concept (Kirchherr et al., 2018) and that the concept has multiple non-converging definitions with multiple interpretations (Homrich et al., 2018; Korhonen et al., 2018; Korhonen et al., 2018a; Schroeder et al., 2019).

In this context, the manufacturing sector has adopted a reductionist approach which reduces circular economy to environmental management practices while neglecting the social aspects of the concept (Barreiro-Gen & Lozano, 2020; Nudurupati et al., 2022).

Consequently, leaving SMMEs to focus only on implementing circular economy activities that have immediate economic and environmental benefits (Dey et al., 2020; Ormazabal et al., 2018; Sohal et al., 2022). Therefore, focusing on material circularity strategies (Kirchherr et al., 2017; Korhonen et al., 2018; Murray et al., 2017) to comply with the environmental management regulations.

Secondly, the barriers to implementing circular economy confirm findings from previous empirical studies on the adoption or transition to a circular economy by SMMEs across the globe. For example, some scholars have concluded that high capital investment is the most significant barrier to the adoption of circular economy (de Jesus & Mendonça, 2018; Gedam et al., 2021). Therefore, confirming the high cost of implementation required for the adoption of circular economy.

On the other hand, other scholars have had similar findings on the lack of government support as a barrier to adopting circular economy (Kirchherr et al., 2018; Sajjad et al., 2020). At the same time, other scholars have also concluded that lack of access to funding is also a barrier for SMMEs to adopt circular economy interventions (García-Quevedo et al., 2020; Malik et al., 2022).

In addition, the study confirmed enabling and driving factors to implement circular economy interventions and business models. In this context, they highlighted the role of government and other stakeholders as enablers for SMMEs to adopt circular economy interventions.

Most importantly, the multiple roles of the government as a possible driver, enable and barriers. In this context, Jabbour et al. (2020) could not confirm the government's role in adopting the circular economy. However, the findings shed some light on the possible roles that government can play through policy development and implementation (de Jesus & Mendonça, 2018).

Further, the study highlighted the need for stakeholder collaboration as the critical enabling factor for adopting and implementing the circular economy. In this context, stakeholders can support resolving multiple barriers that SMMEs are challenged with towards adopting circular economy interventions (Journeault et al., 2021; Sohal & De Vass, 2022; Sohal et al., 2022). The findings further extend the role of stakeholders. Instead of stakeholders being enablers and drivers, stakeholders can also become barriers to implementing a circular economy.

Overall the findings confirm that a circular economy implementation would require the involvement of all stakeholders, including those outside the organisational boundaries (Fehrer & Wieland, 2021).

7.5. Research Limitations and Future Research Areas

The study findings were derived from a setting that included SMMEs within the manufacturing sector. However, due to the purposive snowballing sampling strategy, only a limited number of manufacturing subsectors were covered. Therefore, the insights of the subsectors that were not part of the setting could not be factored into the findings.

Thus, the study recognises that additional factors could be identified from these other subsectors, considering the diversity in the regulations and other factors within the specific sub-sectors. In this context, the study proposes a further exploratory study with a much larger set which includes (i) food and beverage, (iii) textile and clothing, (iii) Wood, Paper and Printing, (iv) Telecoms and Electronic, (v) transport equipment and (vi) Furniture manufacturing subsector.

Further, the setting included SMMEs from a specific geographical location in South Africa. Thus, consideration was only given to SMMEs in Gauteng within chemicals, glass

and non-metallic minerals, metals and machinery, and electrical machinery and equipment manufacturing subsectors.

Therefore, the findings cannot be transferred to another setting outside this geographical area or other economic sectors (Engineering and Construction). Thus, creating another opportunity to investigate further whether the identified factors are equally applicable to other geographical and economic sectors.

In this context, a quantitative study will be suitable to test whether these factors are applicable in these new settings (economic and geographical). The study findings could also be confirmed by industry experts, industry bodies, and organisations involved in the circular economy. The study findings could also be confirmed by industry experts, industry bodies, and organisations involved in the circular economy.

In the same context, further investigation is to establish a correlation (if any exists) between the identified factors and circular economy interventions. Thus, establishing whether the identified factors are only practical to a specific intervention(s) or business model(s). Thus, building a framework for the industry to adopt implementing or adopting circular economy principles.

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Appendices

Appendix 1: CSIR Permission to use the Research Instrument

[Quoted text hidden]

Shavhani Mutshutshu <97162044@mygibs.co.za> 5 August 2022 at 12:39
To: Shahed Fazluddin <SFazluddin@csir.co.za>
Cc: Linda Godfrey <LGodfrey@csir.co.za>

Hello Shahed

Thank you very much for the support.

Parts of the instrument that I am mostly interested in on your questionnaire are those that assess participant's the understanding of CE practices as this will be core to the study. Ithink these are covered mostly in section 1 to 3 of the questionnaire.

I will develop the rest of the questions in line with the proposed research topic.

Please forward me the respective questionnaire with the letter granting me permission to use the questionnaire for submission to ethical clearance.

I am planning to have the draft submitted to my supervisor on the 6 Aug 2022 and would appreciate it if you can send me the requested items sometime during the course of the day today.

Regards

Shavhani Mutshutshu

[Quoted text hidden]

Shahed Fazluddin <SFazluddin@csir.co.za> 5 August 2022 at 14:21
To: Shavhani Mutshutshu <97162044@mygibs.co.za>
Cc: Linda Godfrey <LGodfrey@csir.co.za>, Vincent Ojijo <VOjijo@csir.co.za>

Hi Shavani

Please find attached word version of the survey doc as requested.

I don't think a formal letter is necessary, this email should be adequate.

Trust this fulfils your request.

Regards

CSIR
Shahed Fazluddin
PhD, MSc, BSc (Eng)
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Tel: +27 12 841 2575
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[Quoted text hidden]

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Appendix 2: Semi- Structured Interview Schedule

PART 1: DEMOGRAPHICS/PROFILE

In this section, I would like to request information about your company/organization

1.1. Please indicate which manufacturing sub-sector you are currently active in.

MANUFACTURING SUB-SECTOR	Y/N
· Food & Beverages	
· Textiles & Clothing	
· Wood, Paper, Printing	
· Chemicals (petroleum, plastics)	
· Glass & Non-metallic minerals	
· Metals & Machinery	
· Electrical Machinery & Equipment	
· Financial	
· Telecomms & Electronics	
· Transport Equipment	
· Furniture	
· Other	

If other, please specify: _____

1.2. Please select the category to which your organization belongs.

Type of Organization	Private Sector	Government	NGO	Other

If other, please specify: _____

1.3. How would you classify your organization/enterprise?

Enterprise size	Micro-enterprise	Small-enterprise	Medium-enterprise	Others

If other, please specify: _____

1.4. How many years of experience do you have working in this organization?

Sectoral Experience	< 1 year	1 - 2 years	3 - 4 years	5 - 10 years	> 10 years

1.4. Please indicate your main level of responsibility within your organization?

Level of Responsibility	Y/N
Executive	
Senior Management	
Project Managament	
Engineering/Technical	
R&D	
Finance	
Other	

If other selected, please specify:_____

PART 2: CIRCULAR ECONOMY EXPERIENCE

Circular economy interventions can broadly be categorised under three principles: (i) designing out waste and pollution; (ii) keeping materials and products in use, and (iii) regenerating natural systems. This survey seeks to appraise a number of proposed circular economy interventions for the South African manufacturing sector.

2.1. Please rate your personal knowledge of the Circular Economy (CE).

CE Knowledge	None	Novice	Working	Good	Excellent

2.2. Are you currently (or have previously been) involved in Circular Economy related projects and/or interventions?

□ Yes
□ No

2.3. How many years of experience do you have with Circular Economy (CE) related projects?

CE Involvement	< 1 year	1-2 years	3-4 years	5-10 years	> 10 years

2.4. Please elaborate on any Circular Economy related projects you are or have been involved in.

1. _____
2. _____

2.5. Is your company affiliated with any Circular Economy related organizations, e.g. ACEN, Ellen McArthur Foundation, WEF, SA Plastics Pact, etc.?

□ Yes
□ No

Please provide details of any such affiliations below.

1. _____
2. _____

PART 3: FACTORS ENABLING MSMEs WITHIN THE MANUFACTURING SECTOR TO IMPLEMENT CIRCULAR ECONOMY PRACTICES

Circular economy interventions can broadly be categorised under three principles: (i) designing out waste and pollution; (ii) keeping materials and products in use, and (iii) regenerating natural systems.

This section will assess the following:

- some of the challenges/barriers to the implementation of Circular Economy activities within manufacturing sector,
- factors that can enable/ has enabled organization within manufacturing sector to implement Circular Economy interventions, and
- factors that will make / has made organization within manufacturing sector want to consider different type(s) of business model(s)

Based on your personal knowledge and experience with the Circular Economy, please provide responses to the following questions or statements.

3.1. Which of the following Circular Economy Interventions are you familiar with?

Circular Economy Intervention	Unfamiliar	Partly Familiar	Familiar	Very Familiar
1. Circular Design & Manufacturing				
2. Remanufacturing				
3. Renewable Energy Technologies				
4. Resource Efficient and Cleaner Production				
5. Circular Textiles Design & Manufacturing				
6. Additive Manufacturing				
7. 4IR Technologies				
8. Material Looping (Recycling, reuse, repair)				
9. Chemical Leasing				
10. Industrial Symbiosis				
11. Bio-based fuels and/or materials				
12. Green Steel Manufacturing Technologies				
13. Circular business models (sharing economy, etc)				

3.2. What would you consider are/were the main obstacles towards the implementation of the proposed Circular Economy interventions for your organization?

3.3. What would you consider are the main factors that can enable/ has enabled your organization to implement Circular Economy interventions?

3.4. What would you consider are the main factors that will make / has made your organization want to consider different type(s) of business model(s) (e.g. sharing economy, circular product design, collection and reverse logistics, etc.)?

3.5. Please provide any additional information you consider relevant to the implementation of the Circular Economy within your organization?

3.6. Do you know any other organization that the researcher may speak to for advancing this research?

Appendix 3: Informed Consent Letter

Gordon Institute of Business Science
University of Pretoria

Informed Consent Letter

Dear Participant

I am conducting research on Factor enabling micro, small and medium enterprises (MSMEs) within the manufacturing organization to adopt circular economy practices. Our interview is expected to last one and half-hours, and will help us understand what will make MSMEs want to adopt circular economy practices? Your participation is voluntary, and you can withdraw at any time without penalty. By signing this letter, you are indicating that you have given permission for:

- the interview to be recorded;
- the recording to be transcribed by a third-party transcriber, who will be subject to a standard non-disclosure agreement;
- verbatim quotations from the interview to be used in the report, provided they are not identified with your name or that of your organisation;
- the data to be used as part of a report that will be publicly available once the examination process has been completed; and
- all data to be reported and stored without identifiers.

If you have any concerns, please contact my supervisor or me. Our details are provided below.

Researcher name: **Shavhani Mutshutshu** Research supervisor name: **Hugh Myres**
Email: 97162044@mygibs.co.za Email: myresh@gibs.co.za
Phone: Phone:

Signature of participant: _____

Date: _____

Appendix 4: List of Codes

Table 7

List of generated codes from Atlas.to.22

Code	Grounded	Density	Code Groups	
○ Demographics				70
	● Sectoral Experience			12
		● 3 to 4 years		3
○ Demographics				70
		● Electrical Machinery and Equipment		1
	● Enterpize Size			17
	● Environmental Barriers			44
	● Environmental Factors			46
	● Environmental Factors			29
		○ Excellent Knowledge		1
	● Level of Responsibility			13
		● Executive		11
○ Circular Economy Strategies				136
	● CE Interventions - Familiar			44
		○ 4th Industrial revolution technologies - Familiar		3
	● CE Interventions - Partly familiar			18
		● 4th Industrial revolution technologies - Partly Familiar		2
	● CE Interventions - Unfamiliar			56
		○ 4th Industrial revolution technologies -Unfamiliar		5
	● CE interventions - Very familar			18
		○ 4th Industrial revolution technologies -Very Familiar		1
		● 5 to 10 years		3
		○ Additive Manufacturing		5
		○ Additive Manufacturing - Unfamiliar		5
		○ Additive Manufacturing - Very Familiar		1
○ Circular Economy Strategies				136
		○ Circular inputs- Waste		1
		○ Circular Textile Design and Manufacturing - Unfamiliar		9
		○ Circular Textile design and Manufacturing - Very Familiar		1
		● Circular Textile design and Manufacturing- Partly Familiar		1
		● Chemicals(Petroleum and Plastics)		5
		○ Circular Business Models - Familiar		4
		● Circular Business Models - Partly familiar		3
		○ Circular Business Models - Unfamiliar		3

Code	Grounded	Density	Code Groups	
		○ Circular Business Models - Very Familiar		2
		○ Circular Design and Manufacturing		4
		○ Circular Design and Manufacturing - Unfamiliar		1
		○ Circular design and Manufacturing - Very Familiar		1
		● Circular Design and Manufacturing -Partly Familiar		4
		○ Circular Design and Manufacturing strategies		3
		○ Green Steel Manufacturing		2
		○ Green Steel Manufacturing - Unfamiliar		9
		○ Industrial Symbiosis		3
		○ Industrial Symbiosis - Unfamiliar		6
		○ Industrial Symbiosis - Very Familiar		2
		○ Industrial Symbiosis interventions		1
		○ Bio-based Fuels and/or Materails		4
		● Biobased Fuels- Partly Familiar		2
		○ Biobased Fuels- Very Familiar		1
		○ Biobased Fuels-Unfamiliar		4
○ Circular Economy Expereince				74
	● CE Affiliation			14
		○ Affiliations with circular economy orginsations - No		10
		○ Affiliations with circular economy orginsations- Yes		4
○ Barriers and Challenges				80
○ Factors for CBMs				50
	● Social Factors			8
		○ CBM - Goals - Management Commitment		4
		○ CBM - People -Human Capital		4
	● CE Affiliation			14
	● CE Interventions - Partly familiar			18
	● CE Interventions - Familiar			44
	● CE Interventions - Unfamiliar			56
	● CE interventions - Very familar			18
	● CE involvement			12
	● CE Knowldge			12
	● CE Projects - examples			22
○ Factors for CE implementation				71

Code	Grounded	Density	Code Groups	
	● Environmental Factors			46
		● CEI - Financial/Economic Factors		8
			● CEI - Availability and Access to Funding	8
	● Social Factors			10
		● CEI - Goals		7
			● CEI -Management Commitment	7
	● Technical Factors			15
		● CEI - Process		12
			○ CEI - Availability of Feedstock	1
			○ CEI - Innovation	1
			● CEI - Operational Benefits	10
		● CEI - Regulatory Frameworks		2
			● CEI - Institutional pressure (Government)	2
		● CEI - Stakeholders		36
			● CEI - Government Support	9
			○ CEI - Market Availability	1
			○ CEI - Sharing best Parctices	6
			○ CEI - Stakeholder Collaborations	10
			● CEI- Customer Awareness and Pressure	7
			● CEI- Ecological Concerns	3
		● CEI People		3
			● CEI - Capacity Building (Training)	3
		● CEI- Knowledge		3
			○ CEI - Knowledge and Understanding of CE	3
		○ Chemical Leasing		3
		● Chemical Leasing - Partly Familiar		1
		○ Chemical Leasing - Unfamiliar		4
	● Manufacturing Subsector			16
○ Circular Economy Expereince				74
	● Social Barriers			7
		○ Cultural Barriers		4
			○ Top Manager's values inclination	4
○ Factors for CBMs				50
○ Factors for CE implementation				71
		○ Financial/ Economic Circumstances		0

Code	Grounded	Density	Code Groups	
		● Financial/Economic Barriers		9
			● Lack of access to Funding	9
		○ Five to ten years		7
		○ Good Knowledge		7
	● Technical Factors			13
		○ Infrustructure - Proximity to customers		1
	● Technical Barriers			29
		● Knowledge Barriers		4
			● Barriers - Lack of CE Knowledge	4
		○ Less than 1 year		1
		● Less than one year		1
	● Level of Responsibility			13
	● Manufacturing Subsector			16
		○ Materails Looping		10
		○ Materials Looping (Recycling, reuse, repair)		6
		○ Materials Looping (Recycling, resue,repair) - Unfamiliar		1
		○ Materials Looping(Recycling) - Very Familiar		4
		● Medium enterprise		8
		● Medium to large enterprise		2
		● Metals and Machinery		5
		● Micro enterprise		4
		● More than 10 years		5
		○ More than ten years		3
		○ Novice		2
		● Others		5
		● People Barriers		3
			● Lack of capacity (Skills)	3
	● Personal Involvement -CE			14
		○ Personal involvement on Circular economy- No		2
		○ Personal involvement on Circular economy- Yes		12
	○ Private sector organizations			12
		○ Process		2
		● Process Barriers		25
			● Poor quality of recycled materials (process)	7
			● Process - Cost of implemention	18
			● Process- Reputation Risk Management	2

Code	Grounded	Density	Code Groups	
		○ Refurbishment		5
		● Regulatory Frameworks (Barriers)		5
			● Institutional Barriers (Policy Frameworks and Implementation)	5
		○ Remanufacture and reuse		2
		○ Remanufacturing		6
		● Remanufacturing - Partly familiar		2
		○ Remanufacturing - Unfamiliar		2
		○ Remanufacturing - Very familiar		1
		● Renewable Energy Technologies - Partly familiar		1
		○ Renewable Energy Technologies - Unfamiliar		4
		○ Renewable Energy Technologies - Very familiar		2
		○ Resource Efficient and cleaner production - Familiar		4
		● Resource Efficient and cleaner production - partly familiar		2
		○ Resource Efficient and cleaner production - Unfamiliar		3
		○ Resource Efficient and cleaner production - Very familiar		2
	● Sectoral Experience			12
		● Senior Manager		2
		● Small enterprise		2
		● Small to medium enterprise		1
	● Social Barriers			7
	● Social Factors			8
	● Social Factors			10
		● Stakeholder Barriers		30
			● Barrier - Customer Attitudes (Non-acceptance of CE Products/Services)	15
			● Barriers - Lack of Customer Awareness	6
			● Berriers - Lack of Government Support	3
			● Misalignment between industry stakeholders	6
		○ Stakeholders		29
			○ CBM - Access to New Markets	9
			○ CBM - Culture - Shift in Consumer Attitudes	1
			○ CBM - Government Support	6
			○ CBM - Partnership	1
			○ CBM - Sharing best Practices	1
			○ CBM - Socio-ecological benefits	11
	● Technical Barriers			29
		○ Technical Factors		10

Code	Grounded	Density	Code Groups	
		○ Refurbishment		5
		● Regulatory Frameworks (Barriers)		5
			● Institutional Barriers (Policy Frameworks and Implementation)	5
		○ Remanufacture and reuse		2
		○ Remanufacturing		6
	● Technical Factors			13
	● Technical Factors			15
			○ CBM - Economic Gains	8
			○ CBM - Knowledge - Access to Information	2
		○ Three to four years		1
		○ Working Knowledge		2

Note: Created by owner using Atlas.ti.22 software

Appendix 5: Ethical Clearance

Gordon Institute of Business Science
University of Pretoria

Ethical Clearance
Supervisor Notification

Dear Hugh Myres,

Please be advised that Shavhani Mutshutshu's application for Ethical Clearance has been approved.

We wish Shavhani Mutshutshu everything of the best for the rest of the project.

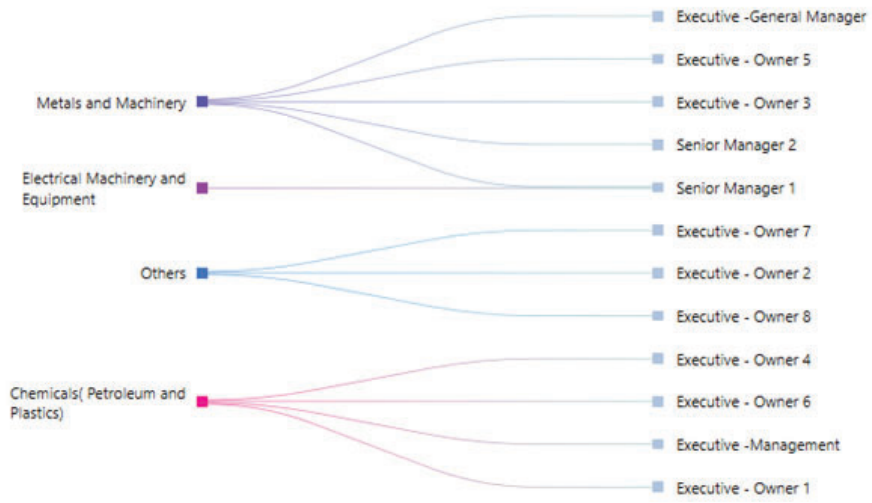
Kind Regards

This email has been sent from an unmonitored email account. If you have any comments or concerns, please contact the GIBS Research Admin team.

Appendix 6: Demographics – Manufacturing Subsector and Enterprise size

Figure 13

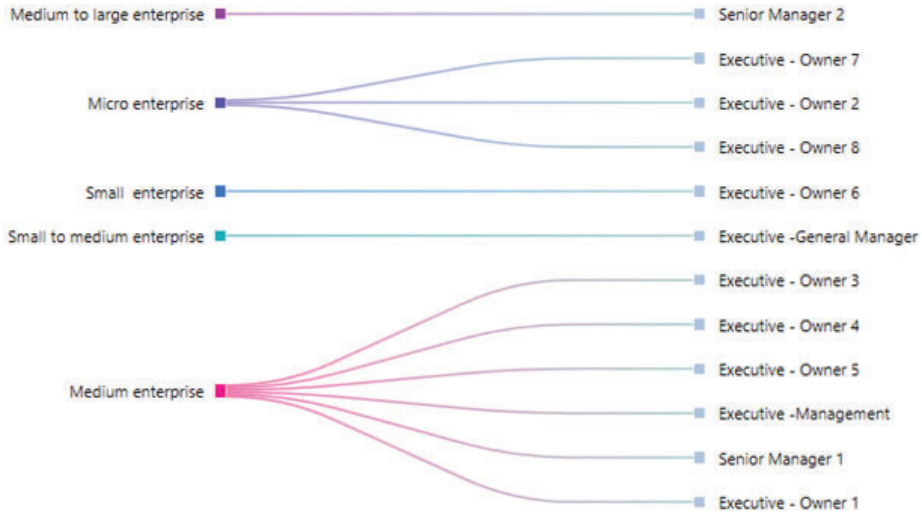
Distribution of manufacturing sub-sectors among study participants



Note: Created by owner using Atlas.ti.22 software.

Figure 14

Distribution of enterprise size among study participants



Note: Created by owner using Atlas.ti.22 software

Appendix 7: Demographics – Sectoral Experience and level of Responsibility

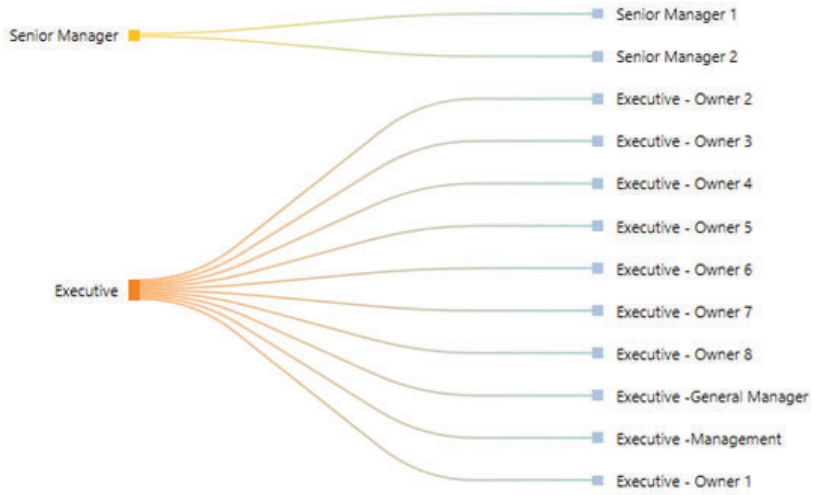
Figure 15

Illustration of the number of years' sectoral experience between participants

Note: Created by owner using Atlas.ti.22 software

Figure 16

Illustrations of participants' level of responsibility



Note: Created by owner using Atlas.ti.22 software

Appendix 8: Familiarity with Circular Economy Interventions

Table 8

Knowledge of circular economy interventions (Relative Frequencies)

	Circular Economy Interventions	Level of Familiarity			
		Unfamiliar	Partly Familiar	Familiar	Very Familiar
1	4th Industrial revolution technologies	7.591	**20**	2.884	8.333
2	Additive Manufacturing	4.723	0	**14.306**	3.571
3	Bio-based Fuels and or Materials	2.625	8.25	8.254	1.19
4	Chemical Leasing	4.717	6.25	10.476	0
5	Circular Business Models	2.725	8.214	10.873	**11.905**
6	Circular Design and Manufacturing	2.033	**14.916**	5.489	2.976
7	Circular Textile Design and Manufacturing	**24.472**	4.545	0	2.381
8	Green Steel Manufacturing	**31.077**	0	8.682	0
9	Industrial Symbiosis	7.477	0	7.331	7.44
10	Materials Looping (Recycling, reuse, repair)	0.794	0	**19.429**	**34.524**
11	Remanufacturing	2.803	**15.909**	9.244	4.167
12	Renewable Energy Technologies	6.886	7.143	0	**13.69**
13	Resource Efficient and cleaner production	2.077	**14.773**	3.033	9.821
	Totals	**100.00**	**100.00**	**100.00**	**100.00**

Note: Created by owner using Atlas.ti.22 software

Appendix 9: Factors enabling (inhibiting) SMMEs to implement circular economy practices

Figure 17

Distribution of factors inhibit the implementation of circular economy interventions by SMMEs within the Socio-technical systems framework

Note: Created by owner using Atlas.ti.22 software

Figure 18

Distribution of factors enabling the implementation of circular economy interventions by SMMEs within the Socio-technical systems framework

Note: Created by owner using Atlas.ti.22 software

Figure 19

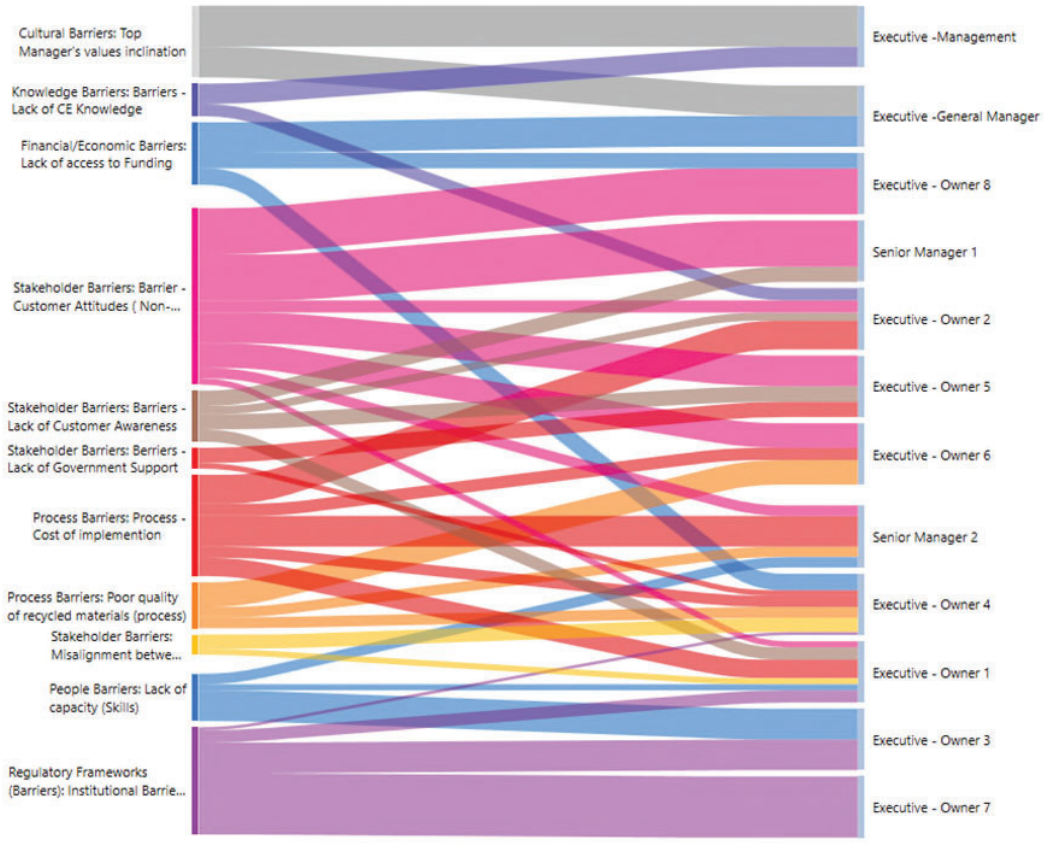
Distribution of factors enabling the adoption of circular business models by SMMEs within the Socio-technical systems framework

Note: Created by owner using Atlas.ti.22 software

Appendix 10: Barriers to the implementation of circular economy interventions

Figure 20

Overall representation of social barriers themes in line with the STS framework. Analysis of the responses from participants.



Note: Created by owner using Atlas.ti.22 software

Appendix 11: Social Barriers to the implementation of circular economy interventions

Figure 21

Social barriers themes inhibiting SMMEs to implement CE interventions – themes in line with the STS framework. Analysis of the responses from participants

Note: Created by owner using Atlas.ti.22 software

Figure 22

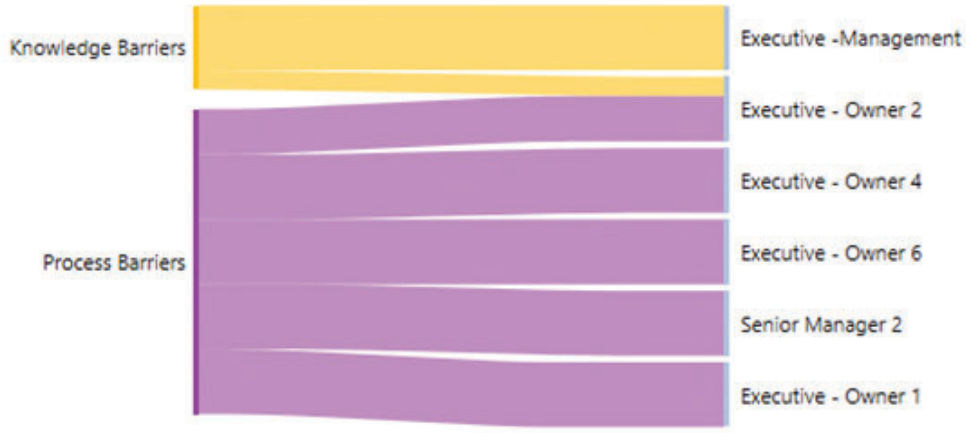
Identified social barriers themes in line with the STS framework – themes from the participant's response

Note: Created by owner using Atlas.ti.22 software

Appendix 12: Technical Barriers to the implementation of circular economy interventions

Figure 23

Technical barriers themes inhibiting SMMEs to implement CE interventions – Themes in line with the STS framework – themes from the participant's response



Note: Created by owner using Atlas.ti.22 software

Figure 24

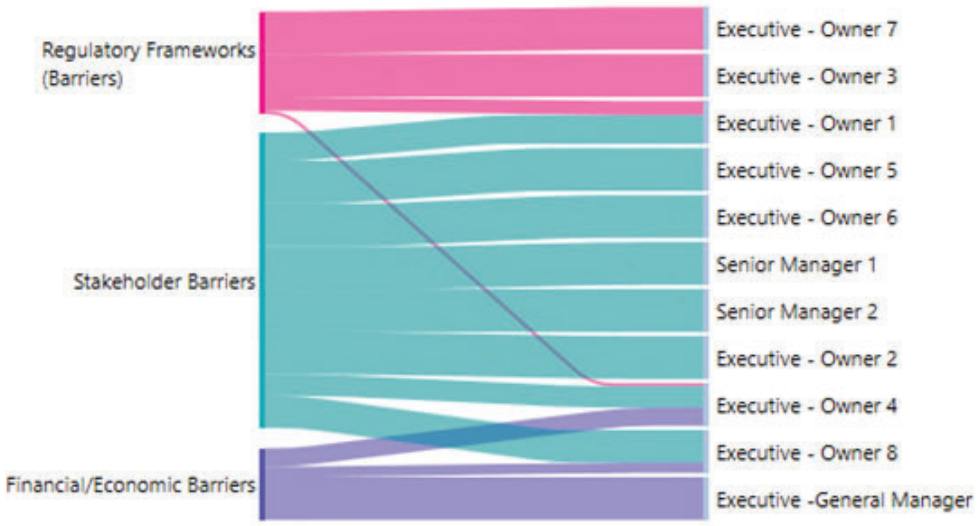
Identified technical barriers inhibiting SMMEs to implement CE interventions-themes in line with the STS framework – themes from the participant's response

Note: Created by owner using Atlas.ti.22 software

Appendix 13: Technical Barriers to the implementation of circular economy interventions

Figure 25

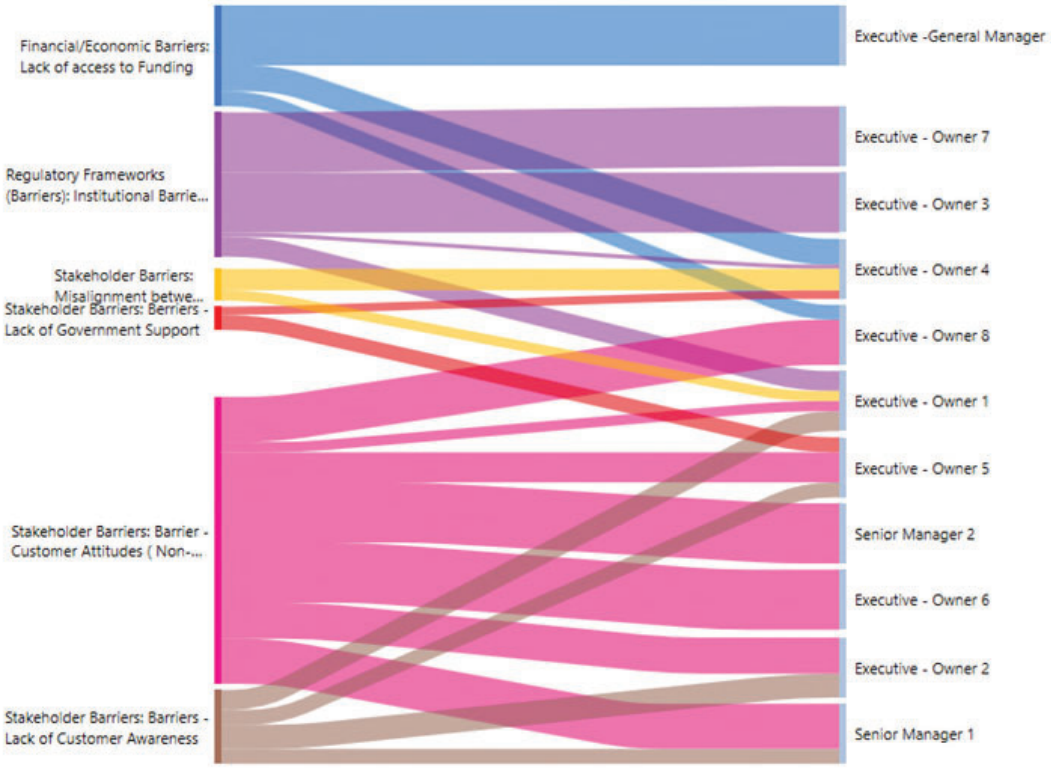
Environmental barriers inhibiting SMMEs to implement CE interventions- themes in line with the STS framework – themes from the participant's response



Note: Created by owner using Atlas.ti.22 software

Figure *26*

Identified Environmental barriers inhibiting SMMEs to implement CE initiatives - themes in line with the STS framework – themes from the participant's response

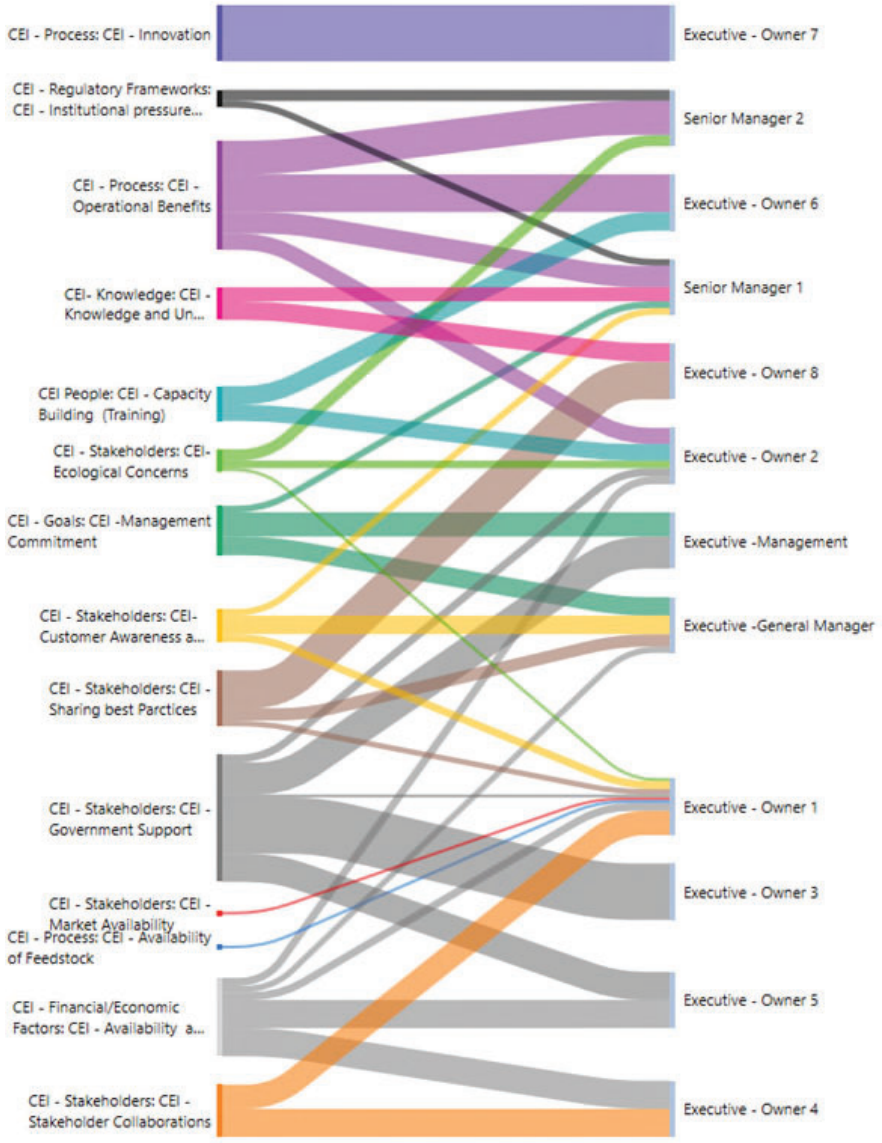


Note: Created by owner using Atlas.ti.22 software

Appendix 14: Factors enabling the implementation of circular economy interventions

Figure 27

Overall representation of factors factor enabling the implementation of CE initiative – themes in line with STS framework. Analysis of the responses from participants



Note: Created by owner using Atlas.ti.22 software

Appendix 15: Social factors enabling SMMEs to implementation of circular economy interventions

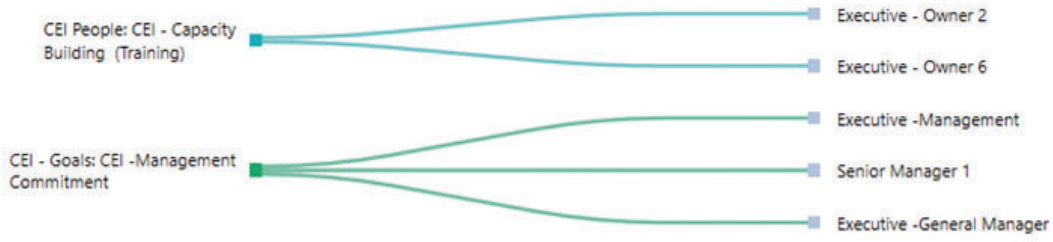
Figure 28

Social factors enabling SMMEs implementation of CE initiatives, themes s in line with the STS framework. Analysis of the responses from participants

Note: Created by owner using Atlas.ti.22 software

Figure 29

Identified social factors enabling SMMEs to implement CE interventions - themes in line with the STS framework – themes from the participant's response



Note: Created by owner using Atlas.ti.22 software

Appendix 16: Technical factors enabling SMMEs to implementation of circular economy interventions

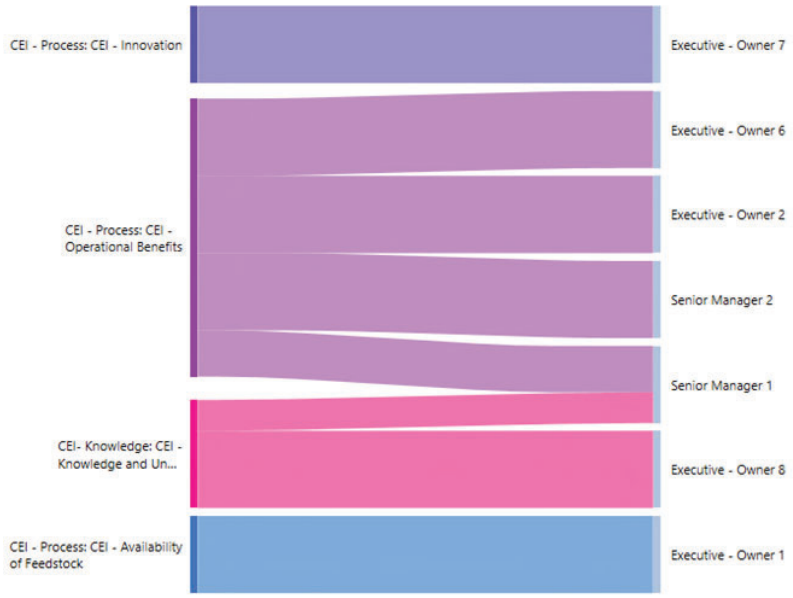
Figure 30

Technical factors enabling SMMEs implementation of CE initiatives, themes in line with the STS framework. Analysis of the responses from participants

Note: Created by owner using Atlas.ti.22 software

Figure 31

Identified technical factors enabling SMMEs to implement CE interventions - themes in line with the STS framework – themes from the participant's response

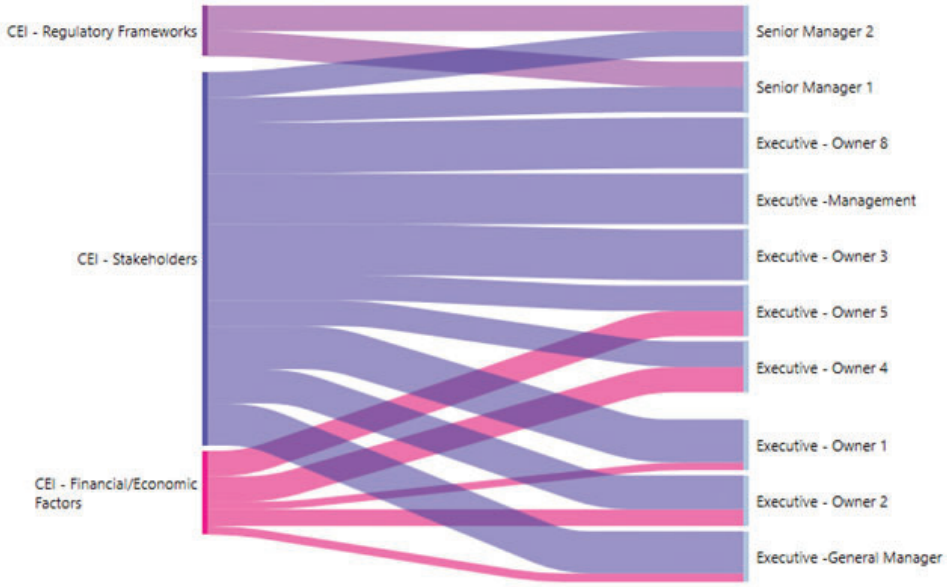


Note: Created by owner using Atlas.ti.22 software

Appendix 17: Environmental factors enabling SMMEs to implementation of circular economy interventions

Figure 32

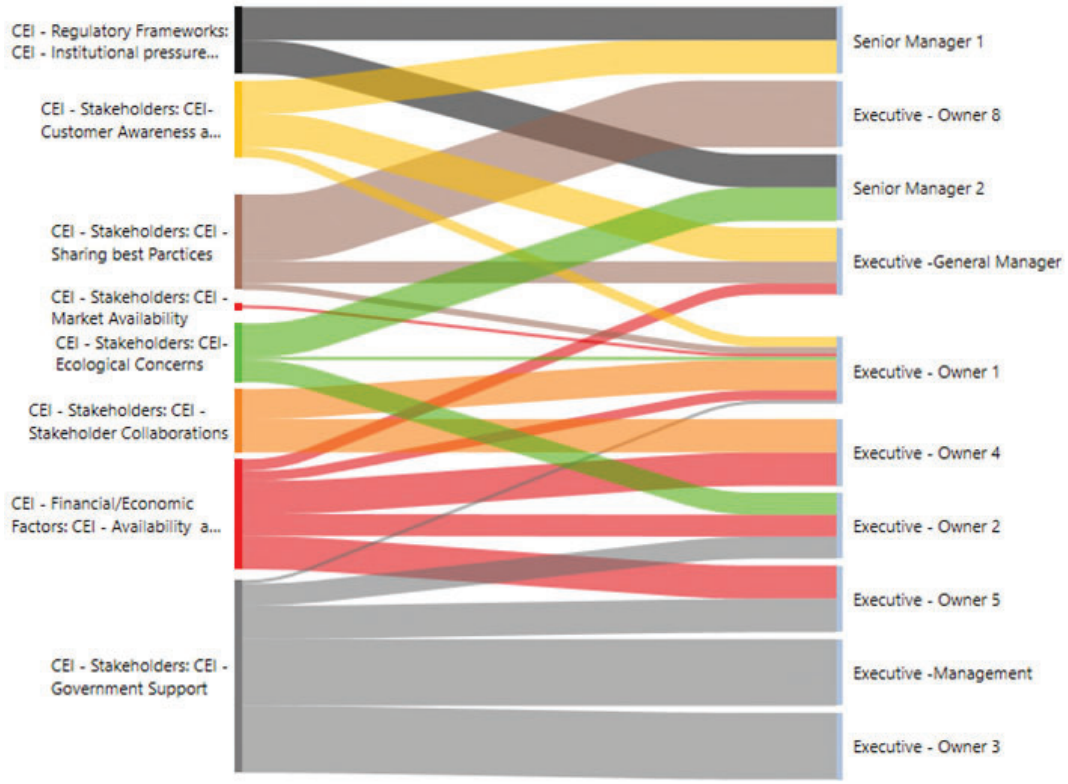
Environmental factors enabling SMMEs implementation of CE initiatives, themes in line with the STS framework. Analysis of the responses from participants



Note: Created by owner using Atlas.ti.22 software

Figure 33

Identified technical factors enabling SMMEs to implement CE interventions - themes in line with the STS framework – themes from the participant's response

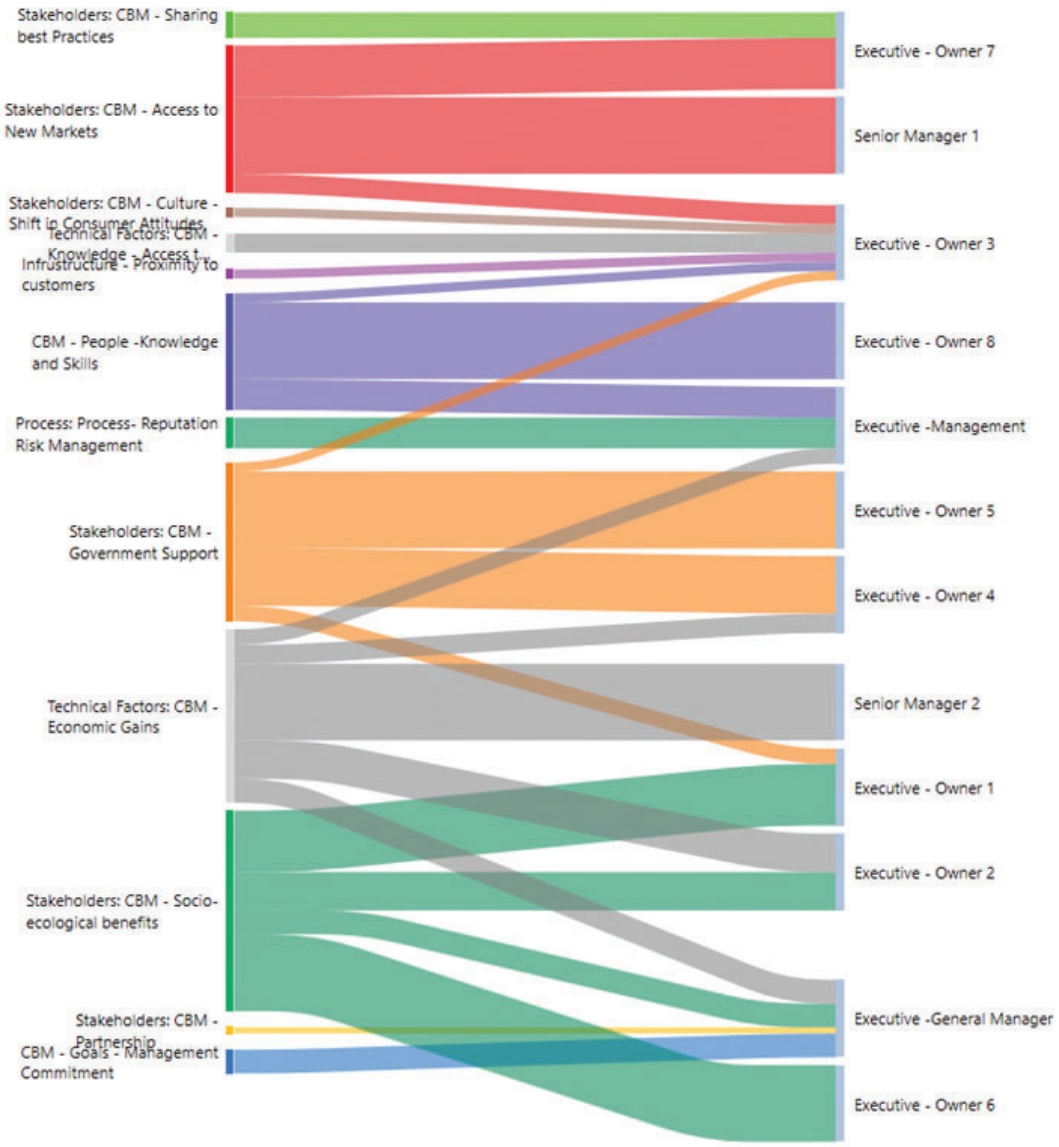


Note: Created by owner using Atlas.ti.22 software

Appendix 18: Factors enabling the implementation of circular Business Models

Figure 34

Overall representation of factors factor enabling the implementation of CBMs – themes in line with STS framework. Analysis of the responses from participants

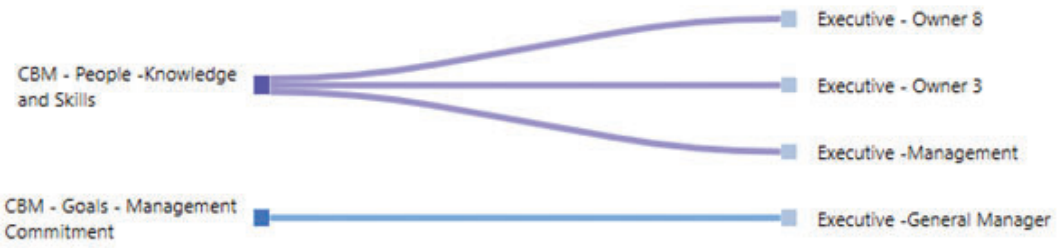


Note: Created by owner using Atlas.ti.22 software

Appendix 19: Social factors enabling the implementation of circular Business Models

Figure 35

Identified social factors enabling SMMEs to implement CBMs - themes in line with the STS framework – themes from the participant's response

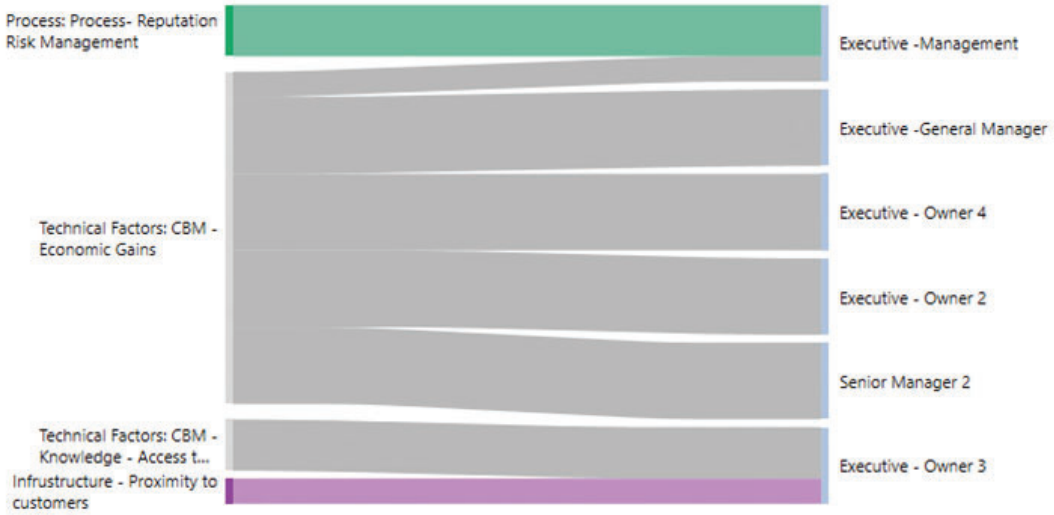


Note: Created by owner using Atlas.ti.22 software

Appendix 20: Technical factors enabling the implementation of circular Business Models

Figure 36

Identified social factors enabling SMMEs to implement CBMs - themes in line with the STS framework – themes from the participant's response

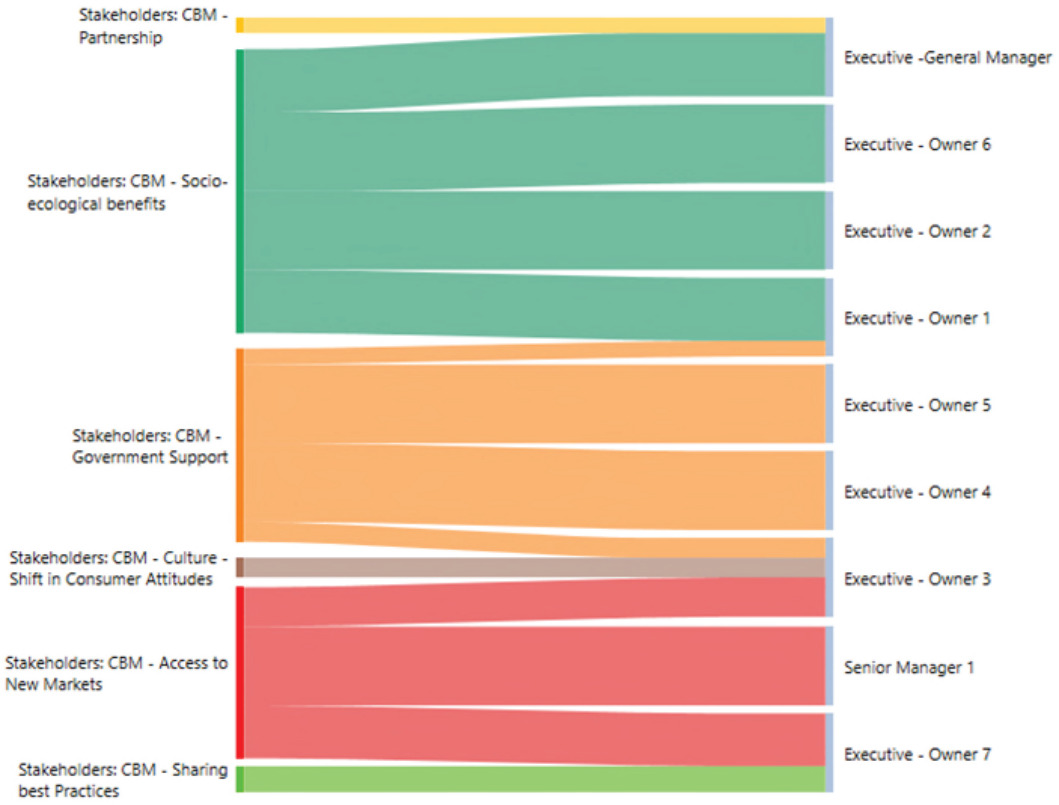


Note: Created by owner using Atlas.ti.22 software

Appendix 21: Environmental factors enabling the implementation of circular Business Models

Figure 37

Identified social factors enabling SMMEs to implement CBMs - themes in line with the STS framework – themes from the participant's response



Note: Created by owner using Atlas.ti.22 software

Appendix 22: Summary of barriers to the implementation of circular economy interventions

Table 9

Summary of barriers to the implementation of circular economy interventions.

Socio-technical systems	STS Dimension	Identified Barriers	Reference section	Supporting Literature
Social	Culture	Top Manager's values inclination	6.4.1.1	Kirchherr et al. (2018), Sharma et al.(2021) and Yamoah et al. (2022)
	People	Lack of capacity (Skills)	6.4.1.1	García-Quevedo et al.(2020), Nudurupati et al.(2022), Sharma et al. (2022)
Technical	Knowledge	Lack of CE Knowledge	6.4.1.2	Gedam et al. (2021), Kirchherr et al. (2018)
	Process	Poor quality of recycled materials	6.4.1.2	Paletta et al., (2018) and Ranta et al.(2018)
		Cost of implementation	6.4.1.2	García-Quevedo et al.(2020), Journeault et al. (2021), Kuhlmann et al. (2022), Marrucci et al. (2021), Sohal et al. (2022), and Sharma et al.(2021)
Environmental	Regulatory Frameworks	Institutional Barriers (Policy Frameworks and Implementation)	6.4.1.3	de Jesus and Mendonça (2018)
	Stakeholder	Customer Attitudes (Non-acceptance of CE Products/Services)	6.4.1.3	de Jesus and Mendonça (2018) and Patwa et al. (2021)
		Lack of Customer Awareness	6.4.1.3	Kirchherr et al. (2018), Patwa et al. (2021) and Sharma et al. (2021)
		Lack of Government Support	6.4.1.3	Govindan and Hasangic (2018), Hopkinson et al. (2018) and Sajjad et al. (2020)
		Misalignment between industry stakeholders	6.4.1.3	(Barreiro-Gen & Lozano, (2020) and Sohal et al. (2022).
	Financial/Economic Circumstances	Lack of access to Funding	6.4.1.3	García-Quevedo et al.(2020) and Malik et al. (2022)

Note: Created by owner using Atlas.ti.22 software

Appendix 23: Summary of Factors enabling the implementation of circular economy interventions

Table 10

Drivers and enablers for SMMEs to implement circular economy interventions

Socio-technical systems	STS Dimension	Identified Factors	Reference section	Classification	Supporting literature
Social	People	Capacity Building (Training)	6.4.2.1	Enabler	Prieto-Sandoval et al. (2019), Sohal et al., (2022), and Sharma et al. (2022)
	Goals	Management Commitment	6.4.2.1	Enabler	Kitsis and Chen (2021), Sarja et al. (2021), Sharma et al. (2021) and Wijethilake and Lama (2019)
Technical	Knowledge	Knowledge and Understanding of the CE Concept	6.4.2.2	Enabler	de Jesus and Mendonça (2018); Hofmann and Jaeger-Erben (2020), and Moktadir et al. (2020)
	Process	Operational Benefits	6.4.2.2	Driver	Govindan and Hasanagic (2018), Ormazabal et al. (2018) Nudurupati et al.(2022)

Socio-technical systems	STS Dimension	Identified Factors	Reference section	Classification	Supporting literature
Environmental	Regulatory Frameworks	Institutional pressure (Government)	6.4.2.3	Driver	Govindan and Bouzon, (2018),Govindan and Hasanagic (2018) and Kirchherr et al. (2018)
	Stakeholders	Government Support	6.4.2.3	Enabler	Alonso-Almeida et al.(2021), ; Malik et al.(2022), Moktadir et al. (2020), Sharma et al. (2022) and Virmani et al.(2022)
		Sharing best Practices	6.4.2.3	Enabler	Katz-Gerro and López Sintas (2019), Marrucci et al. (2021)
		Stakeholder Collaborations	6.4.2.3	Enabler	Aarikka-Stenroos et al.(2022) and Journeault et al.(2021)
		Customer Awareness and Pressure	6.4.2.3	Driver	Govindan and Bouzon, (2018), Mostaghel & Chirumalla (2021) and Wang et al. (2020)
		Ecological Concerns	6.4.2.3	Driver	Centobelli et al. (2020), Govindan and Bouzon (2018), and Mehmood et al.(2021)
	Financial/Economic Factors	Availability and Access to Funding	6.4.2.3	Enabler	Austin and Rahman, (2022), García-Quevedo et al. (2020) and Sharma et al. (2018)

Note: Created by owner using Atlas.ti.22 software

Appendix 24: Summary of Factors enabling the implementation of circular business models

Table 11

Drivers and enablers for SMMEs to implement circular business models

Socio-technical systems	STS Dimension	Identified Factors		Reference section	Classification	Supporting literature
Social	People	1	Knowledge and Skills	6.4.3.1	Enabler	García-Quevedo et al.(2020), Nudurupati et al.(2022), and Sharma et al. (2022)
Technical	Process	2	Economic gains - profitability	6.4.3.2	Driver	Bocken and Ritala (2022), Chen et al.(2021), Friant et al.(2020), and Hu et al.; (2021)
Environmental	Stakeholders	3	Government support	6.4.3.3	Enabler	Alonso-Almeida et al.(2021), Malik et al.(2022), Moktadir et al. (2020); Sharma et al.(2022), and Virmani et al. (2022)
		4	Socio-Ecological benefits	6.4.3.3	Driver	Govindan & Bouzon, 2018; Govindan & Hasanagic, 2018; Kirchherr et al., 2018; Prieto-Sandoval et al., 2021
		5	Access to New markets	46.4.3.3	Driver	Ferasso et al. (2021), Mostaghel and Chirumulla, (2021), and Tunn et al. (2019)

Note: Created by owner using Atlas.ti.22 software