Gordon Institute of Business Science
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Green innovation and circular economy in South African supply chain organisations

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ABSTRACT

South Africa has complex environmental and economic challenges as part of its sustainable development. These include depleting natural resources, significant waste generation and high carbon emissions, compounded with an economic growth rate below global growth. Organisations within the supply chain play a key role in purchasing and distributing goods that underpin the economy. Waste generation and carbon emissions drive climate change which has been singled out as a significant risk to humanity. The negative environmental impacts of climate change, resource depletion, waste generation and carbon emissions have compounded the bleak economic outlook for South Africa.

Developed countries have implemented circular economy policies that support green innovation within the supply chain. The circular economy is a model that supports waste reduction while improving the economy and the use of natural resources through reducing, reusing and recycling at a basic level. The research area of circular economy in the supply chain is trending globally and is still relatively new from a South African context, particularly around circular business models in the supply chain. Circular economy principles work hand in hand with driving green innovation, as the technology allows for the identification of new ways to reduce waste and cost across the supply chain.

The research is qualitative and exploratory within the area of supply chain, with a focus on green innovation and circular economy from a developing country perspective. It intends to understand the key drivers that contribute to companies adopting green innovation strategies. The benefit of the research is for practitioners to understand how South Africa can achieve green in the supply chain and overcome economic issues by adopting circular economy principles.

Twelve semi-structured interviews were carried out with managers of large organisations that have embarked on green initiatives within the supply chain. The study established commonalities with existing research on external and internal drivers supporting green innovation and the circular economy in the supply chain. The research established new insights around South African organisations' differences in the supply chain, particularly around operational risk being a critical driver considering water scarcity and electricity instability.

It also identified internal drivers to changing business models from linear to circular, particularly around sustainability strategies, network collaboration, sustainability culture and changing the way companies are measured. Recommendations support how business models could be adapted to drive circular business models across supply chain organisations in South Africa.

KEY WORDS

Green innovation, Supply chain, Circular economy

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 Business Administration 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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Abdul Ganie Hassim

29 March 2021

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. CHAPTER 1: INTRODUCTION

This research paper studies the drivers of green innovation and circular economy in South African organisations that contribute significantly to supply chain activity. The study follows an inductive qualitative approach exploring the phenomena that drive and enable circular supply chains, circular business models and green innovation. The study contributes to the theory on circular economy in supply chains by understanding what drivers support South African supply chains compared to global studies and what unique drivers are relevant in a developing economy context.

The study's practical contribution lies in integrating the drivers supporting green innovation and circular economy business models in the supply chain. The enabling drivers also include practical examples of which green technologies provide the best value in commencing a green journey based on participants experiences. A circular business model based on the literature has been extended to include the enabling drivers of green and circular economy in the supply chain.

The methodological approach followed in the study was aligned to other studies that had carried out qualitative research in recent years across other countries. Thematic analysis was performed on participant interviews to present and analyse data according to the research question and sub-questions. Data validity and quality was implemented through controls in the qualitative methodology strategy. Data triangulation was achieved using supporting company documents that covered sustainability in the organisation.

This introductory chapter provides a contextual background to the research problem and explains the motivations and purpose of the research. South Africa has complex issues around low growth, societal issues, natural resource depletion and large amounts of waste in the supply chain. Global warming is impacting several countries negatively in the form of climate change and natural disasters. South Africa can leverage green innovation and circular business models being implemented globally that may support a shift in the South African economy and improve its sustainability.

1.1. Research problem

Global climate change impact

Sustainability has been highlighted as a significant focus in the coming decade, particularly combatting climate change and its impacts as mentioned in the sustainable development goals by the United Nations. Some of the key measures to mitigate climate change are to reduce carbon emissions, reduce the effects of pollution in the environment, control waste management and become more “green” or environmentally sustainable (United Nations, 2020). The rising temperature of the earth and the oceans, along with the high levels of greenhouse gas (GHG) emissions or carbon emissions, presents a significant threat to humanity and the earth’s biodiversity. Carbon emissions produced locally in one country impacts the earth as a whole, making it a global problem. Various governments have joined forces as part of the Paris Agreement since 2015, whereby targets have been set to reduce carbon emissions and hold global temperatures from increasing further (Boyle, 2018).

Global supply chain activity is growing at an unsustainable rate, resulting in a negative impact on the planet’s resources. Supply chain activity relating to transport accounts for 23 percent of carbon emissions globally, making it one of the most significant individual contributors to climate change (Venturini, Karlsson, & Münster, 2019). This has necessitated a need to innovate towards low carbon alternatives to reduce the impact supply chain has on emissions and improve sustainability.

South African economy and climate change

From a South African perspective, the government has highlighted that the condition of South Africa’s environment continues to deteriorate. South Africa has committed to transition towards a low carbon and climate-resilient society by adopting the National Climate Change Policy and ratifying the Paris Agreement (Department of Forestry, Fisheries and the Environment, 2019). By adopting this agreement, South Africa has pledged to peak its carbon emissions between 2020 and 2025 before reducing them in the 2030s. Key issues for South Africa’s supply chain relate to environmental shocks around water scarcity, stability and cleanliness of electricity generation and an economy that depends on natural resources. South Africa's infrastructure is primarily built on linear principles of take, make and dispose, resulting in high supply chain wastes, carbon emissions and inefficiency (Carbon Brief, 2018).

The government's incentives and taxes include carbon taxes and allowances to stimulate green innovation to reduce carbon emissions, however they have not yielded the desired impact. South Africa has the highest rank on the African continent for carbon emissions, with a combined emission production three times all of Africa combined (Ganda & Milondzo, 2018). They also rank 14th in the world amongst the highest carbon emitters. The primary sources of South Africa's carbon emissions are coal-fired power stations, industry and transportation. While there has been a commitment to introduce renewable energy projects, South Africa has been criticised for not being more active in driving change towards environmental sustainability (Carbon Brief, 2018).

Understanding issues in supply chain

Supply chain management includes the combination of processes from purchasing goods in the production process and related logistics and distribution from source to the consumer making up the supply chain. Green supply chain management includes green logistics, green purchasing, and legislation to achieve a more environmentally friendly value chain. Cirera and Muzi (2020) mention that innovation helps achieve improved productivity for an organisation and boosts economic growth. Countries in the developed world that have implemented innovation towards achieving green supply chains have experienced increased economic growth and lowered the risk to the environment.

Green supply chain is an essential component as it aims to improve the emissions to operate in an environmentally friendly manner and improve overall firm performance (Jermsittiparsert, Namdej, & Somjai, 2019). The decarbonisation of supply chain is necessary to improve carbon emission footprint and reduce related economic and environmental cost (Goedhals-Gerber & Freiboth, 2018).

Green supply chains include the management of supply chains to improve profit and reduce the environment's negative impact. Green supply chain is an integral part of the sustainable supply chains as it focuses on the environmental impact. Increased awareness, market pressures and stricter government regulation have increased attention being given to sustainable supply chains. Sustainable supply chain management requires more depth in understanding the innovations that drive advancement in green (Kusi-Sarpong, Gupta, & Sarkis, 2019).

Organisations that adopt green practices in supply chain have differentiated from competitors and are effective in achieving savings and profit. It is both the customer and supplier's responsibility to consider the environmental impact of the supply chain. (Jermsittiparsert, Siriattakul, & Wattanapongphasuk, 2019). Global supply chains have not yet fully transitioned towards green innovation practices despite the daily operations producing a relatively high portion of waste to the environment. The result of this is an increased contribution to climate change which in turn has brought about more frequent natural disasters and impacted human living conditions (Tran, Wong, Moslehpour, & Xuan, 2019).

More research is required to improve the interrelationship of how the supply chain can develop green solutions. The research on green supply chain management has not focused on the complete supply chain but rather the manufacturer. Organisations involved in green logistics were assessed in European environments to establish current and future activities towards sustainable development (Abbasi & Nilsson, 2016). The current green practices these suppliers are involved in include making internal resources more efficient and effective, behavioural changes towards green, measurement and carbon emissions assessment.

Future green practices towards environmental sustainability include innovation and research, energy and fuel efficiency, as well as increasing awareness. Due to increased pressure on cost and timely delivery, organisations in the supply chain have to compromise environmental friendliness to meet the reduced rates and time expected by customers. Legislation and technology uncertainty contribute to companies decreasing investment in green infrastructure and assets within the supply chain (Abbasi & Nilsson, 2016). Few academic articles address the drivers to improving environmental and sustainability practices in supply chain from a South African perspective. Achieving alignment across different stakeholders in the supply chain to prioritise the needs of green is also a challenge.

There is a growing need for supply chain service providers and manufacturers in ensuring their supply chain is environmentally friendly. This is due to legislation, increased mobility of goods and customer demand for greener products. Prior research done in developed countries indicates that the adoption of green innovation in supply chain is impacted by barriers such as regulation, management strategy and

market forces (Centobelli, Cerchione, & Esposito, 2017). These will need to be tested in a developing economy context such as South Africa to understand the drivers for adopting green innovation in supply chain.

1.2. Research purpose

The research aims to determine the key drivers supporting green innovation and circular economy in the South African supply chain. Research in developed economies has framed drivers and barriers experienced in implementing green in supply chain. Understanding the drivers to implement green innovation and circular economy in developing economies will benefit organisations through improved profitability and environmental benefits. Technology implementation can leapfrog South African organisations' challenges, particularly around attracting investment, improving job creation, creating green supply chains, and reducing inefficiency. The research explores the circular economy model as the theoretical framework in the context of green supply chains and whether this theory can enable green and improve economic performance in a South African context.

The circular economy model has been viewed as an economic model to be able to improve environmental sustainability at the same time improving economic performance. Circular economy principles and green supply chains are concepts that fit quite closely together. More research needs to be carried out to determine the applicability of circular economy practices towards improving economic and environmental impacts on supply chains (Seroka-Stolka & Ociepa-Kubicka, 2019).

The research objectives that follow are to better understand the perspectives of South African supply chain firms in terms of how they view the green and the circular economy towards integrating a circular supply chain business model. As a second objective, the circular economy is explored in relation to green innovation in supply chain to determine drivers for implementation across South African organisations. An analysis will be presented on the key drivers for change that can be understood within the circular economy framework and around green supply chains.

From a South African perspective, it would be essential to bridge the drivers unique to South African conditions, what green innovations can improve the supply chain and what business model changes would need to be considered in strategy. Figure 1 reflects how the theory can relate to the issues in South Africa’s supply chain.

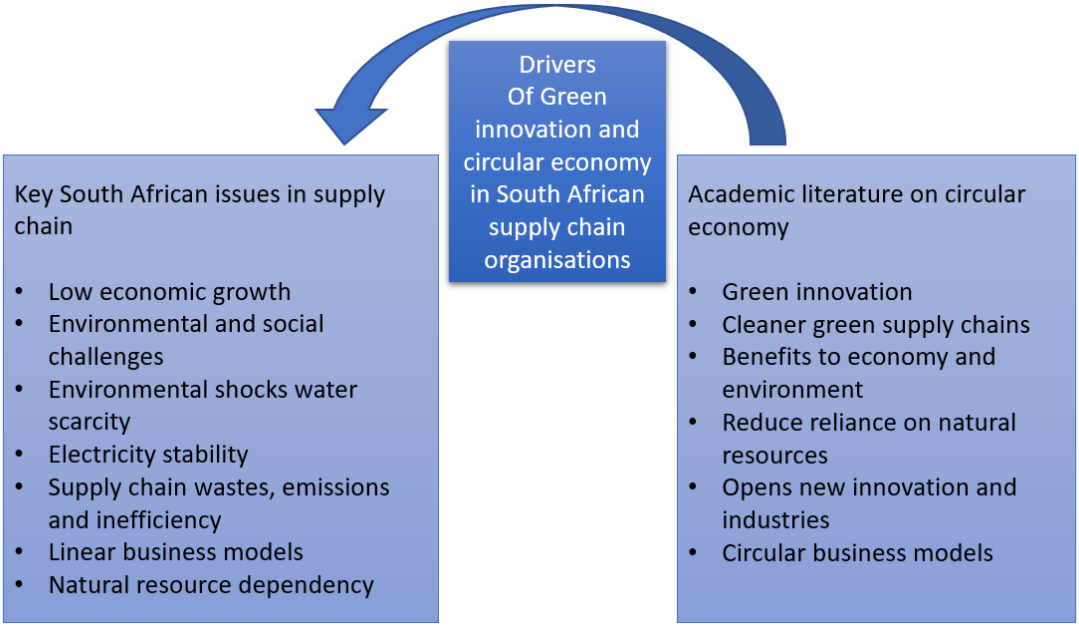


Figure 1: Bridging academic literature and the research problem

The research will benefit managers of companies that engage in supply chains activities to support strategic planning around developing a green economy. Other stakeholders that will benefit from this research include executives involved in supply chain and sustainability as well as academics interested in circular economy and green supply chain models. The merging of knowledge that resides within individuals working towards green supply chains will provide a platform for change in South Africa's supply chain.

2. CHAPTER 2: LITERATURE REVIEW

The literature review was carried out through an iterative process of identifying and sourcing journals based on key words in online libraries. The scope of the literature was based on the research purpose identified in Chapter 1 around the drivers and motivations for adopting the circular economy and green innovation in the supply chain, particularly with a view of improving the environment and at the same time increasing economic benefits. Search terms included green innovation, supply chain, circular economy and combining these terms with “drivers”, “business models”, “and” and “or” to provide more depth on the subject. Mainly highly ranked journal articles were reviewed based on the international journal accreditation listing, with the period focussed on journals written in the past five years that were peer-reviewed and carried out internationally. The journal articles were critiqued to collate comparative arguments on the subject to form more refined research questions and objectives. A summary of the literature areas is presented below to frame the rest of this Chapter.

Table 1: Literature review focus areas

Section	Literature area	Reason for including in literature review
2.1.	Green versus sustainability	Sustainability refers to social, environment and economy, whereas green is primarily focused on the environment. Agreeing terminology will channel the research discussions
2.2.	Green supply chains and green innovation	Understanding the area of green supply chains and linking how green innovation supports green supply chains
2.3.	Circular economy	Bringing in the core framework that supports green supply chains and green innovation. Discuss the benefits and successes of the circular economy
2.4.	Drivers of green innovation and circular economy in the supply chain	Exploring prior research carried out on drivers that support the implementation of green and circular economy in the supply chain. Identifying whether prior research can be used in a South African supply chain context
2.5.	Circular business models	Exploring circular business models that have been used globally
2.6.	Circular supply chains	Understanding how the circular economy and green supply chains can merge to form circular supply chains
2.7.	Literature review matrix	A summary of the arguments and critique across the research toward formulating the research questions

The circular economy framework will form the central focus of the research with subsections on the drivers and explanation of green supply chains, green innovation and circular business models.

2.1. Green versus sustainability

Sustainable development is the ability for development to occur to meet the needs of the present without having to compromise the needs of those in the future. The three aspects of economic, social and environmental are interconnected, meaning that the impact on one of the pillars of sustainability impacts the other two. Sustainable development is best described through the United Nations sustainable development goals, whereby each goal addresses different challenges faced globally (United Nations, 2020). The term environmental sustainability, green and sustainable development are conceptually different as green focuses on environmental sustainability and not necessarily the social and economic aspects included in sustainable development (Millar, McLaughlin, & Börger, 2019).

2.2. Green supply chains and innovation

Green supply chain management has been a focus over the past decade due to climate change and environmental degradation. Over this time, green supply chain management has been integrated into strategy as it provides focus on improving the environment and competitiveness in the supply chain. It achieves this by relooking how green initiatives and innovation can be brought into the supply chain and, at the same time, improve efficiency and cost (Micheli, Cagno, Mustillo, & Trianni, 2020). For example, innovating how products are designed and incorporating end-of-life considerations impacts green and potentially increases profit.

When it comes to logistics in the supply chain, the impact can result from supply chain movements on the environment or the day-to-day operations from warehousing and energy usage, resulting in carbon emissions (Petljak, Zulauf, Stulec, Sering, & Wagner, 2018). Green purchasing also has an impact on carbon emissions, such as packaging and waste generation. Green logistics and green purchasing are functions of green supply chains to improve carbon emissions from logistics and reduce waste (Petljak et al., 2018).

Green in the supply chain is hampered mainly because economic concerns come first before the environment. Customers focus on time and cost reduction in the supply chain, which adds significant pressure to deliver sustainable initiatives. Investment commitment to sustainable initiatives is decreased by uncertainties around technology development, regulation and customer priorities (Abbasi &

Nilsson, 2016). These points link closely to the barriers to implementing green innovation in supply chain. Difficulties are also experienced in setting up the measurement to benchmark green supply chain initiatives to assess the environmental impact (Abbasi & Nilsson, 2016).

Innovation within firms in developing economies is difficult to measure due to a lack of recognised measurements. Innovation has the potential to improve economic growth and productivity (Cirera & Muzi, 2020). Green innovation is largely considered innovation that focuses on reducing waste, preventing pollution, and implementing systems that manage the environment. Research has been conducted in a Taiwanese context whereby the factors affecting green innovation from an external perspective included having green suppliers, market demand for greener products, and environmental regulation (Soewarno, Tjahjadi, & Fithrianti, 2019). Internal factors included environmental ethics, commitment towards green, having the right human capital and adaptability to move towards green.

Green innovation in supply chain can be classified in many ways, including sustainability goals, carbon footprint reduction, alternative fuels, and carbon emissions reduction. These initiatives can further be classified into those carried out by the organisation internally and those carried out externally in collaboration with partners. Extending green innovation across the value chain is essential for achieving environmental sustainability (Centobelli et al., 2017). Previous studies globally have identified the performance improvement both from an economic and environmental point of view following the implementation of green innovation in the supply chain. Similar studies are yet to be carried out from a South African perspective, and hence the research will aim to understand this further.

While economic and environmental performance was understood to improve through green innovation, not all aspects of organisational performance were considered in the literature. The ability to improve innovation such as traceability or tracking across the supply chain has proven to directly influence improved environmental performance and, to a lesser extent operating cost improvement (Cousins, Lawson, Petersen, & Fugate, 2019). There is a need to understand the green technologies that can contribute to improved economic and environmental benefits in South African companies.

Technology improvement has played a significant role in driving green innovation in logistics. Data-driven techniques allow for implementing machine learning across the value chain in transportation to improve fleet management or traffic flow prediction (Veres & Moussa, 2020). These techniques support optimising supply chain performance, thus improving the environmental impact. The term freight sharing allows for the transportation of goods in a shared environment, reducing cost to the consumer (Standing, Standing, & Biermann, 2018). Green innovation in supply chain can take many forms, and hence a better understanding is needed of what constitutes such innovation.

2.3. Circular economy

The theoretical framework of the circular economy is closely linked to green innovation and green supply chains as they all aim to address environmental and economic issues. The circular economy allows for the achievement of economic improvement while at the same time ensuring minimal environmental impact. It differs from the linear model, whereby the linear model promotes economic growth through raw material extraction, production and discarding of waste (Ellen MacArthur Foundation, 2019).

The circular economy has received more prominence in the last decade, with a significant increase in the literature over the past five years. The circular economy's key themes in recent literature have been around broadening collaboration across various stakeholders, closing material loops towards green, circular supply chains and redesigning products towards cleaner production (Reike, Vermeulen, & Witjes, 2018).

The circular economy has had many attempts at a definition however, the one proposed by Bressanelli, Perona and Saccani (2019) probably is the most complete as they include the framework prescribed by the Ellen McArthur Foundation in presenting their definition as below,

> *"an economic system restorative and regenerative by design, implemented by one or more supply chain actors through one or more of the four building blocks (circular product design, servitised business models, reverse logistics and enablers) in order to replace the end-of-life concept with reducing,*

> *alternatively reusing, recycling and recovering materials in production, distribution and consumption processes, for both technical and biological materials, with the aim to accomplish sustainable development."* (Bressanelli, et al., 2019, p. 7396).

The current issues around climate change and environmental degradation are attributed to the linear economy model, which is unsustainable to the environment and society. The circular model aims to regenerate components and maintain the highest utility at all times, thus reducing cost and waste from the system (Ellen MacArthur Foundation, 2019). The most widely understood circular economy concepts incorporate reducing, reusing, recycling (3R concept) and recovering materials used in production, distribution, and consumption. The circular model should have the optimal level of closed loops of material and energy flow to promote sustainable development (Millar et al., 2019).

Reike et al. (2018) compared the circular economy's successes in developed countries to developing counties. Policies implemented in developed countries towards achieving circularity have improved recycling waste up to 46% on average. In developing countries, there is a lot more informal approach to recycling which yielded less than 3%, particularly in Brazil and South Africa. More research needs to be done to determine how developing countries can increase the adoption of circular principles.

Govindan and Hasanagic (2018) add that the 3R concept has been extended into the 6R concept by adding in the terms recover, redesign and remanufacture. The extended terminology results from the success achieved in applying circular economy principles, particularly in the European Union, which has shown that reuse and recycling by example have reduced the waste going into landfills by 36% and decreased life cycle costs (Govindan & Hasanagic, 2018). Depending on the focus of particular regions, the number and description of the R concept may vary. The most common 3R variations are to reduce, reuse and recycle according to the United Nations and OECD (Reike et al., 2018). At a basic level, these concepts aim to eliminate waste by decreasing natural resource inputs into production or bringing products back into the supply chain through reuse and, finally to recycle materials.

The Ellen McArthur Foundation has developed a circular economy model that indicates the closed-loop cycle. It shows how the 6R concept can be applied to

technical (blue arrows) and biological (green arrows) aspects in the value chain to move towards a circular business model. Examples of technical nutrients are metals and plastics, which should be recycled, remanufactured and reused within a closed loop. The bio-nutrients should ideally be returned to the biosphere in a manner that achieves environmental sustainability (Ellen MacArthur Foundation, 2019). This diagram highlighted the circular economy's intention to reduce waste and raw material consumption to achieve green.

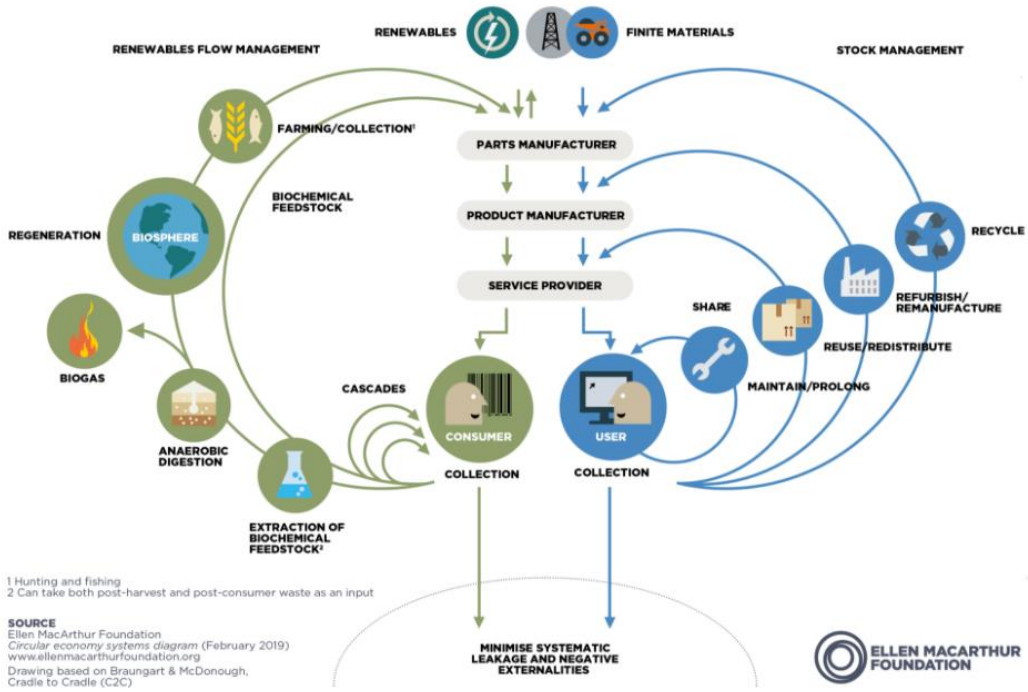


Figure 2: Closed-loop cycle of circular economy

(Ellen MacArthur Foundation, 2019)

Govindan and Hasanagic (2018) mention that the reason for including one or more supply chain actors in the definition highlights the close relationship between the circular economy and supply chain. It also supports the idea that it may not be practical for an organisation to capture the entire value chain to form a closed loop or vertically integrate across the supply chain. The end-to-end process requires collaboration and agreement across the various actors in the supply chain to coordinate efforts on circular economy such as reverse logistics, end-of-use recycling or designing material choice to achieve circular endeavours towards environmental and potentially sustainable development.

More needed to be understood from a developing economy context of how these circular economy principles can be applied to achieve similar outcomes. This makes

the theory relevant when considering from a supply chain point of view as there is a strong relationship between the drive for green innovation in supply chain and adopting the circular economy model.

2.3.1. Circular economy and green innovation in supply chain

Millar et al. (2019) state that current economic development models are primarily linear and hence cause detriment to the environment and society. Sustainable development involves achieving economic prosperity whilst benefitting society and reducing damage to the environment. There is an argument that the circular economy may not answer all issues of sustainable development. Circular economy tends to be more focussed on the environmental aspects or “green” to promote economic development, rather than sustainable development as a whole. Circular economy was best positioned as an environmentally sustainable tool, promoting both green and the economy with the potential to improve social aspects of sustainability.

It is argued that the circular economy is not time-bound, making the vision of implementing the circular economy vague. The growing demand for material resources is still expected to continue, and hence it is further argued that circular economy will only benefit the linear economy by prolonging the outcome of environmental degradation (Millar et al., 2019). It is interesting to understand perspectives of supply chain organisations on whether circular economy could work in South Africa.

Reike et al. (2019) concluded that businesses need to adapt business models for their specific supply chains to incorporate which of the R’ concepts in circular economy are feasible. More research could be done in determining a simplified approach of adopting circular economy business models into the supply chain to incorporate the principles set out.

Millar et al. (2019) stated that the circular economy could not achieve environmental sustainability through using current technology as particular wastes cannot breakdown or be reused further based on current infrastructure. Hence, there is a need from an environmental perspective to implement innovation and improve infrastructure to support the circular economy. Despite these arguments, there is a preference for business to promote circular economy as it encourages innovation

and seeks to split out the economic growth and resource dependency that currently resides in the linear economy. The longer-term view is that resource depletion can be de-risked by implementing circular economy principles in the near future to develop into a more sustainable development model, whether in the pure sense of sustainable development or from an environmental sustainability point of view (Milar et al., 2019). A further question that arises from this is how the drivers would be implemented in circular economy in South Africa.

Green supply chain and logistics is an inherent condition towards building a circular economy due to the requirement of logistics and distribution of products within the closed-loops of a circular economy. It supports the circular economy model, which is directly linked to sustainable development (Seroka-Stolka & Ociepa-Kubicka, 2019). Green supply chain management, green innovation and circular economy are all linked. Green innovation is needed to develop green supply chain management, and green supply chain resides within the circular economy framework.

Cousins et al. (2019) mention that green innovation in supply chain will support circular economy principles as it intends to reduce waste from the system through improved operational efficiency and performance and at the same time, reduce cost. Green innovation will enable various initiatives across the supply chain to reduce carbon emissions at various points. Cousins et al. (2019) go on to mention that green supply chains have been proven to improve environmental and operating cost in studies carried out in the United Kingdom. There are still many barriers that managers within organisations face when trying to implement green innovation. Understanding the drivers to circular economy in supply chain and the link to green innovation will be beneficial to research in a South African context.

2.3.2. Circular economy in the supply chain

Green supply chains are seen as an imperative in strategy and driving competitive advantage. It achieves this by integrating environmental responsibility into the production, purchasing, and logistics systems that underpin the supply chain to reduce the negative impact (Genovese, Acquaye, Figueroa, & Koh, 2017). Circular economy enhances green supply chains by incorporating a self-sustaining view of redesigning material flows and taking a longer-term view on economic growth and innovation. Genovese et al. (2017) highlighted that the longer-term of the circular

economy approach might be challenging to implement as the linear model is more easily understood and achieves efficiency at the expense of green. Circular economy attempts to continually sustain how resources and energy are used over the longer term within the planetary boundaries, thus creating environmental sustainability. In a South African context, where economic recovery is a priority, it is challenging to achieve green in the supply chain through circular economy without achieving improved economic benefit over the short term. The research will seek to address this point through the objectives around the research questions.

2.4. Drivers of green innovation and circular economy in the supply chain

This research paper will help understand the benefit of circular economy in achieving green innovation in the supply chain through implementing circular economy practices. It will also seek to answer the question on the approach to implementing circular economy by identifying the drivers needed to implement green innovation and the approach needed to adapt business models.

Organisations are pressurised by cost, delivery lead time, and service quality as their primary measures and have difficulty balancing these measures to reduce the negative environmental impacts. Legislation has played a large part in a number of countries in supporting behaviour change towards environmentally sustainable practices. From a South African perspective, the introduction of carbon taxes was meant to drive the agenda of improving carbon emissions amongst organisations (Department of Forestry, Fisheries and the Environment, 2019).

Drivers of green innovation are considered as those factors that affect the adoption of environmentally friendly initiatives positively. This is in contrast to barriers which are the negative aspects impacting green innovation adoption. Previous literature reviews have identified no clear framework for both the drivers and barriers of green innovation in supply chain from a South African context. Some of the themes that surfaced from these studies highlighted drivers and barriers globally. The key drivers identified included management's attitude towards green, organisational support, company size, understanding the technology, customer pressure, government support, market factors, company image and profitability (Centobelli et al., 2017). In a Thailand study, drivers for green included legislation, carbon emission reduction, and resolving climate change (Jermsittiparsert et al., 2019). There is a need to

understand drivers that would support the adoption of green initiatives in supply chain within South Africa.

Micheli et al. (2020) undertook a study on drivers and barriers of innovation in green supply chains. In their study, some of the main drivers included green image, competitors and regulation. Their research did not include the circular economy as a framework for implementing green but instead tested the moderating factors through a quantitative approach based on prior research. In another study, drivers to green supply chains resulted from improved company image, efficiency improvements and being a leader in green (Laari, Toyli, & Ojala, 2017). It was established that companies use green for a competitive advantage by market differentiation to raise a higher product value. These studies did not incorporate a South African context, nor did they link the circular economy to green supply chain management. They mentioned that collaboration in the supply chain could be explored further as part of the green supply chain.

Drivers can be categorised into internal and external drivers and ranked in terms of importance. The internal drivers included the ability to increase profitability, the company's image, and support from top management of the innovation. The external drivers included improved customer relationships, the supply chain's effectiveness, government incentives, and initiatives by partners (Tran et al., 2019). The customer also plays a significant role in driving green supply chain practices, and suppliers that respond to the customer demand has proven to improve their brand recognition as an environmentally friendly company. Another driver was a reduction in costs or increased savings as a result of introducing new green innovation. Tran et al. (2019) also noted that the initial costs of green innovation may be significant however the payback period resulted in an improved economic position. These economic and environmental benefits are yet to be fully understood from a South African perspective and how this relates to the circular economy model.

In a further study, internal drivers in green supply chains were identified as environmental vision and committing resources to green. External drivers were regulation, governmental customers, competition and supplier pressure (Huang, Huang, & Yang, 2017). The research was tested in a Taiwanese environment to determine the impact of institutional pressure on green supply chains. A key finding was the green innovation impacts an organisation’s environmental, economic and

competitive performance in a positive manner. The study was limited as it did not factor in how the circular economy could be a model to link green innovation to green supply chains.

Govindan and Hasanagic (2018) carried out a systematic review of the drivers, barriers and practices of circular economy in the context of supply chain management. They argued that the effectiveness of supply chain management impacts organisational performance, and hence a focus was needed to understand the implementation of circular economy in the supply chain. They also substantiated that while circular economy as a concept has been around for many years, the recent literature around its relevance to different supply chain management perspectives is needed. A key point highlighted through their systematic literature review is the rapidly growing number of articles in more recent years covering the topic (Govindan & Hasanagic, 2018).

While Govindan and Hasanagic (2018) had undertaken a systematic review of the drivers, barriers and practices of circular economy in supply chain management, their methodology was based mainly on prior research on the topic to formulate their conclusions. They provided a framework that accounted for a multi-perspective view on implementing circular economy in the supply chain. The drivers included economic growth, increased value proposition, laws and regulations, and increased efficiency. Some of the practices that supported internal drivers of circular economy in the supply chain included strategy and vision, support from top management, education and training (Govindan & Hasanagic, 2018).

The framework provides a guideline of how the circular economy may be driven and implemented in the supply chain. More profound insights into the topic were not established through in-depth interviews and surveys to enhance the richness of the debate on such a topic. Their perspectives were based on European and Asian countries that had shown interest in developing research in the subject area. A further area to cover is the link of green innovation to supply chain management and circular economy that needs to be established (Govindan & Hasanagic, 2018).

Summary of drivers of green innovation and circular economy in the supply chain

Based on the summary of drivers presented, this research will focus on drivers of green innovation and the circular economy in the South African supply chain as an

overarching research question. Understanding practical green innovations will support a South African context to apply circular concepts in supply chain. Circular business models will be explored below to determine how this could contribute to the research question.

2.5. Circular economy business models

Business model innovation is required to be able to incorporate circular economy into the current business models. These incorporate the structure, communication, value proposition and organisational configuration to name a few. The integrated circular business models and supply chain management model gives rise to circular supply chain management (Geissdoerfer, Morioka, de Carvalho, & Evans, 2018). This is a relatively new research area that aims to achieve the same outcomes as green supply chain management and environmental sustainability, however within the closed loops associated with circular economy. Geissdoerfer et al. (2018) explain that supply chain loops seek alternate ways to close the loops and dematerialise them. A circular business model is brought into supply chain management with the intent of waste reduction, emission leakage and better material usage to improve efficiency and generate competitive advantage. Value is created in monetary and non-monetary forms by involving multiple stakeholders participating in the supply chain over the long term. Figure 3 shows a comparison of the business model and how circular business models can support green supply chains.

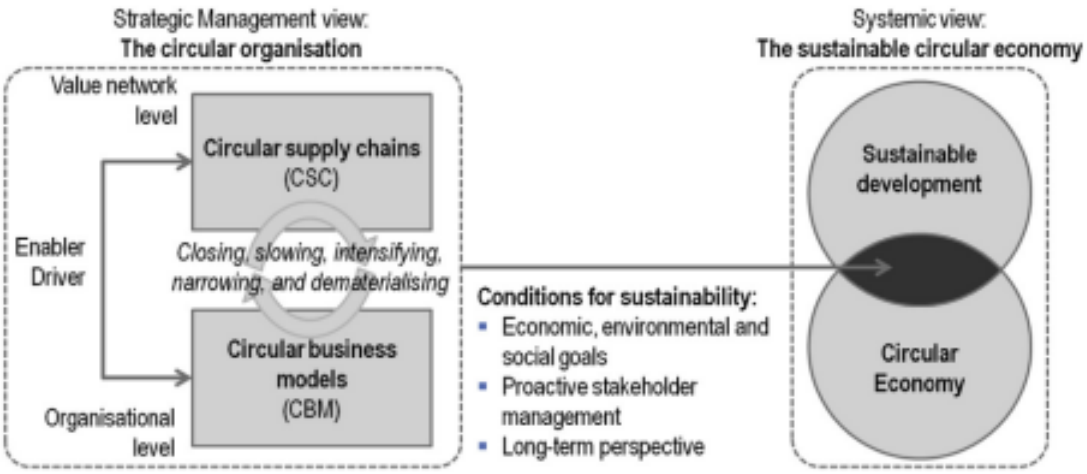


Fig. 3. Proposed framework.

Figure 3: Circular business model

(Geissdoerfer, Morioka, de Carvalho, & Evans, 2018)

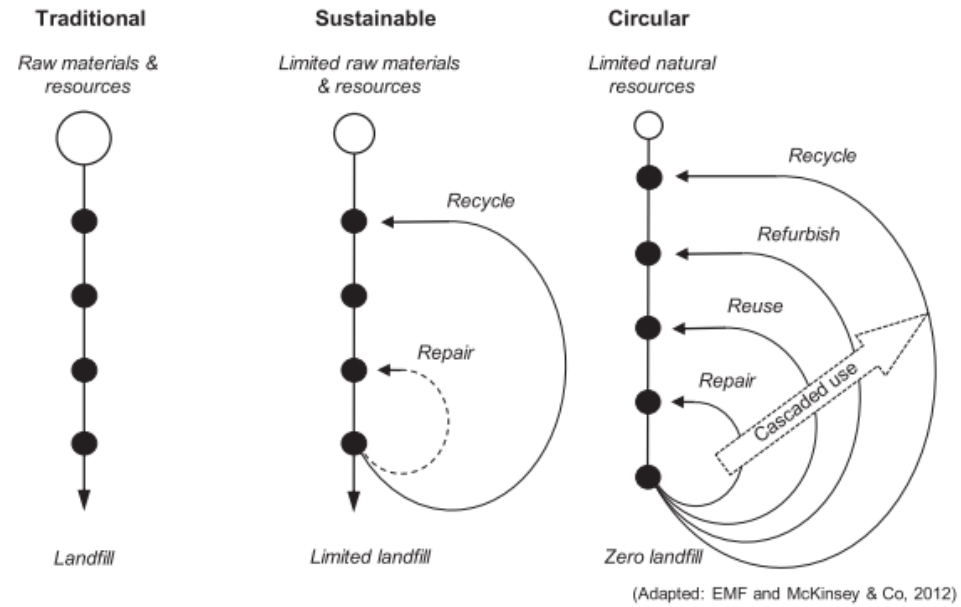
Lewandowski (2016) attempted to adapt the business model canvas used in the linear economy to one that represented a circular economy. The aim was to understand how the circular economy can be adapted to current business value streams. This conceptual framework has not been tested, with unanswered questions such as whether the organisations' value proposition needs to be adapted to a circular economy. Critical success factors would need to be incorporated into the research on circular business models.

Geissdoerfer et al. (2018) state that they had attempted to link sustainable supply chains to the circular business model based on the figure above, which provided a strategic management view and systemic view of circular organisation made up of circular business models and circular supply chains. It would be beneficial to link the enablers and drivers to this model to create a holistic picture of the drivers that support circular supply chains within the strategic management view. This study was done based on a limited number of case studies in the United Kingdom and Brazil. More research should be undertaken to understand how supply chains can be incorporated into circular business models from a South African perspective.

2.6. Circular supply chains

The configuration of supply chains is important to align with circular business models to form what is known as circular supply chains. The key component of circular supply chains involves extending how long materials are kept in use within the supply chain. Certain materials may be restored biologically into nature and are treated as consumables, whereas other materials that can be made more durable through innovation will extend use and efficiency (De Angelis, Howard, & Miemczyk, 2018).

Managers face difficulties in establishing circular supply chains such as how customers may perceive value, the distribution of products, and having flexibility in structure. De Angelis et al. (2018) elaborate that circular supply chains support more regional and local supply to capture increased supply chain value. The figure below shows the differences between traditional, sustainable and circular supply chains whereby the loops within the supply chain are closed, shorter and cascaded to extend the use of resources within the supply chain following circular economy principles.



	Traditional supply chains	Sustainable supply chains	Circular supply chains
Strategy	Component price	Cost of ownership	Leasing and service outcome
Structure	Linear and open	Partially closed	Closed, short and cascaded loops
Flow	Input-output	Mixed throughput	Biological and technical cycles
Focus	Efficiency	Customer effective	Collaborative value capture
Scale	High volume	High-medium volume	Medium-low volume
Scope	Global	Global and regional	Regional and local

Figure 4: Circular supply chains

(De Angelis, Howard, & Miemczyk, 2018)

As part of understanding the challenges in redesigning supply chains to support circular economy, Bressanelli et al. (2019) systematically identified these challenges faced by organisations. Their key finding was that the main actor in the supply chain plays the role of coordinating and applying pressure on other organisations to design the supply chain according to circular economy principles. It is not always possible to achieve a complete closed-loop of environmental sustainability, however any circular endeavour can be considered as achieving the aim of implementing circular economy in the business model. It is valuable to understand how large supply chain organisations in South Africa see themselves as the main actor in establishing green in the supply chain.

Petljak et al. (2018), in a European study, mentioned that a central part of green supply chains involves collaboration across the supply chain, whereby suppliers co-operate around strategies for green logistics and green purchasing. It may be important to link collaboration across the supply chain to circular business models

from a South African perspective.

In another study on circular supply chains, a case study was carried out on comparing circular economy adoption in supply chains across Brazil and China. Leadership featured as a dominant finding whereby leaders developed external capabilities to collaborate with supply chain partners (Batista, Gong, Pereira, Jia, & Bittar, 2019). The main company in the case study played the role of the supply chain actor. They facilitated training and technical advice to other role players in the supply chain to implement green across the supply chain.

2.7. Literature review matrix

The literature review matrix summarises the articles and authors in green supply chain and circular economy. It aims to provide an overview of the discussion to follow what has been discussed on this topic and what can be done in the subject area.

Table 2: Literature review matrix

Literature area	Authors	Findings and methods	Critique
Drivers of green innovation and circular economy	(Govindan et al., 2018; Centobelli et al., 2017; Huang et al., 2017; Tran et al., 2019; Laari et al., 2017; Jermsittiparsert et al., 2019; Micheli et al., 2020)	Various perspectives globally on drivers, barriers and practices to green innovation and circular economy in supply chain. Mix of qualitative studies using case studies, along with conceptual studies based on literature reviews. Some quantitative studies have been used as well on moderating factors.	It is difficult to standardise the various findings across geographies; there is a need to view the literature area from a South African supply chain context. The literature assesses green innovation separate from circular economy and green supply chains, and hence it may be of interest to align these concepts as they have similar aims.
Green innovation and green supply chains	(Cousins et al., 2019; Soewarno et al., 2019; Standing et al., 2018; Abbasi & Nilsson, 2016; Petljak et al., 2018; Cirera & Muzi, 2020; Kusi-Sarpong et al., 2019; Seroka-Stolka & Ociepa-Kubicka, 2019; Jermsittiparsert et al., 2019; Goedhals-Gerber & Freiboth, 2018; Ganda & Milondzo, 2018; Venturini et al., 2019; Veres & Moussa, 2020; Oberhofer & Dieplinger, 2014; Boyle, 2018)	Green innovation strategy has a positive impact on green innovation. Green innovation can take many forms such as renewables, new methods for waste reduction, share and reuse, data driven efficiency improvements Questionnaires and surveys were used as the primary instruments to establish green innovations	Green innovations can be classified in numerous ways, all with the intent to support green supply chains and circular economy. It is not clear from a South African perspective which green innovations makes the most sense to implement towards achieving circular economy.

Literature area	Authors	Findings and methods	Critique
Circular economy and circular business models	(Geissdoerfer et al., 2018; Genovese et al., 2017; De Angelis et al., 2018; Bressanelli et al., 2019; Millar et al., 2019; Reike et al., 2018; Lewandowski, 2016; Batista et al., 2019)	Framework to integrate circular business model and sustainable supply chains Other frameworks on environmental sustainability in supply chain and circular supply chains Mix of qualitative case studies and conceptual models from literature reviews	While there have been many attempts at circular business models, it may be challenging to implement in a developing economy without the correct change drivers in place. Further qualitative research may support how developing economies may begin their green journey towards circular business models.

Based on the above literature summary and critique, it is clear that more needs to be understood from a South African supply chain perspective as to what can drive organisations to adopt green innovation and circular economy in the supply chain. The drivers and barriers presented by Govindan and Hasanagic (2018) from a global perspective may provide a comparative analysis against what organisations in South Africa are experiencing.

It is essential to understand the green innovation strategy of these South African companies as this has a positive impact on the implementation of green towards environmental sustainability. A better understanding of South African companies' environmental benefits and economic benefits will support circular endeavours to implement circular economy across the supply chains.

Circular business models and circular supply chains could be explored in a South African context to understand what changes to the current business models may achieve circular economy goals of environmental sustainability with the prospect of sustainable development as highlighted in the United Nations sustainability goals (United Nations, 2020).

2.8. Summary and conclusion

Circular economy is presented as a framework that can support the greening of supply chains through changing business models and adopting green innovation. The circular economy theory will be used as the core theory of the research, with focus areas to ground the research question. These include the drivers of green innovation and circular economy in the South African supply chain, understanding

circular business models and circular supply chains that could be incorporated in a South African context and exploring which green innovations can support circular economy in the supply chain.

Based on the research conducted to date, the research question on the drivers of green innovation and circular economy in the South African supply chain is yet to be answered. Research presented globally supports how drivers of circular economy in the supply chain can achieve green. The drivers for the research topic can be sub-categorised into external drivers, internal drivers and green innovations that support circular economy in the supply chain. Green innovation and circular economy may assist South African companies through improved economic and environmental benefits to overcome some of the challenges mentioned in Chapter 1. The research will be beneficial for South African organisations that are looking to adapt their business model to become greener.

3. CHAPTER 3: RESEARCH QUESTIONS

3.1. Research question (RQ): What are the key drivers that support green innovation and circular economy in the South African supply chain?

The supply chain in South Africa has the challenge to improve efficiency, reduce cost and, at the same time, adopt green to reduce waste and environmental degradation. Based on the work of Govindan and Hasanagic (2018) and other scholars presented in the literature matrix in section 2.7, there is a gap in the research from a South African perspective. Answering the question on the drivers to support green innovation and circular economy in the South African supply chain will indicate a way to implementing circular economy.

3.1.1. Sub question 1 (SQ1): What are the external drivers of green innovation and circular economy in the supply chain?

Tran et al. (2019) separated drivers into external and internal drivers of green in the supply chain. The external drivers represent those items that push organisations into embarking on a green journey. Answering the question on the external drivers of green innovation and circular economy in the supply chain presented some unique characteristics facing South African companies compared to the global research carried out.

3.1.2. Sub question 2 (SQ2): Which areas of green innovation in the supply chain can result in positive economic and environmental benefits?

Millar et al. (2019) mentioned that current technology needs to be improved to implement circular economy principles such as waste reduction. Understanding the types of green innovation implemented in a South African context makes the circular economy implementation a lot more achievable. Companies are looking to improve economic profit, and hence it was beneficial to link those innovations that drive green and improved profitability into the supply chain.

3.1.3. Sub question 3 (SQ3): What changes (internal drivers) can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy?

The sub-question supports the over-arching research question as it provided insight from an organisational design perspective around strategy, structure and culture that may support the change towards green. The internal drivers provided practical steps that supply chain organisations could take to adapt their business models.

3.1.4. Sub question 4 (SQ4): What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based?

The literature by Geissdoerfer et al. (2018) provided a framework for circular business models. The linear business model used by most organisations currently in South Africa will need to be reassessed should they move towards circular economy. Understanding what changes may be needed from linear to circular business models could help answer how supply chain companies may become green.

4. CHAPTER 4: RESEARCH METHODOLOGY

The research methodology chapter explains the strategy, design, process and analysis of the research methods followed. The study was explorative in nature as green innovation and circular economy in supply chain is still establishing itself in South Africa, and hence there is a need to develop the research further. The research was viewed from a developing economy perspective which was covered in the literature review matrix. The research methodology was more suited to a qualitative study, based on qualitative studies carried out by Bressanelli et al. (2019) and Batista et al. (2019). A background to philosophy and approach is provided below before going into the population, sample and instrument.

4.1. Philosophy

The philosophy was interpretivism as it allowed the phenomena to emerge from the research (Sauders & Lewis, 2018). This philosophy also allowed a better understanding of the behaviour of people and created context. During the data gathering, respondents were asked about their company background and their organisation experiences to better relate to large supply chain organisations in South Africa. A learning approach was taken, mainly to understand the complex nature of the business world (Dilley, 2004).

4.2. Approach

In a similar study carried out in a European environment, a qualitative approach was considered most appropriate. Interviews were carried out to provide in-depth insights from the respondents to understand decision-making and contextual background (Oberhofer & Dieplinger, 2014). The inductive nature of the research enabled themes to develop compared to the theoretical frameworks presented. The research questions were split into four sub questions to bring in themes of green innovation, circular economy and business models relating to supply chain.

The qualitative approach created the space for observation of behaviours, whereby the theories could explain the behaviours. Inductive reasoning is strengthened as the scope, diversity and volume of observations increase (Ang, 2014). This made the inductive approach more relevant to green innovation in the supply chain as there were increased observations through the qualitative process.

4.3. Methodological choices

A mono method qualitative study was undertaken due to the nature of the research described. A mixed-method approach was not recommended due to the time frame and complexity involved in completing the study. Batista et al. (2019) conducted a study on circular supply chains whereby the research was conducted through qualitative analysis. They chose a qualitative case study methodology as the focus was on a specific company across more than one geography. For this research, a qualitative approach was adopted with semi-structured interviews across more organisations to get a broader perspective of the South African specific context towards green. A quantitative methodology was also not considered appropriate due to the emerging nature of the research from a South African perspective. The qualitative method supported the deeper insights needed to be able to explore the subject area in the developing economy context.

4.4. Purpose of research design

The purpose of using qualitative research had the benefit of explaining the research observations and theories. It became more humanistic in focus as it aimed to be able to provide practical understanding around the drivers for green innovation and circular economy in supply chain. It was intended that real-life insights into the participants and their organisations' strategies would allow for the insights and analysis to emerge. The participants were open to sharing strategies to provide what worked and what did not work so well in their businesses.

4.5. Strategy

In-depth semi-structured interviews were carried out with interviewees that represented large organisations involved in supply chain. The methodical approach to each interview ensured the details from interview questions became structured themes that emerged from the research. The researcher could then establish the relations from the text in the interview recordings to derive a deeper understanding of the drivers to green innovation (Dilley, 2004). Secondary data complemented the research process and provided support to models induced through the research process. The secondary data could be used to triangulate data obtained through the interview process. These documents would include annual reports of the companies that represented JSE listed organisations to understand their green innovation strategy and their performance against the strategy.

4.6. Time horizon

Due to the short time frame, a cross-sectional study was undertaken whereby data was collated at a point in time (Sauders & Lewis, 2018). The data was collected over a two-month period.

4.7. Techniques and procedures

Techniques and procedures included the process by which interviews were carried out by the interviewer. These are defined further in the design section.

4.8. Population

The population included managers of South African companies involved in supply chain with expertise in driving sustainability within the organisation. The managers had five years or more experience in working within the sector. It was assumed that the five years provides sufficient time for the manager to understand the issues being faced by the stakeholders around developing a sustainability agenda. With this experience, they were able to impart knowledge to the study around the drivers to green innovation from a South African perspective and how the circular economy model can support green supply chains. These managers influenced strategic objectives around green innovations that could benefit the company and increase economic and environmental benefits. The company's size was large businesses as they were considered as having the most significant impact on the carbon emissions from logistics in South Africa.

4.9. Unit of analysis

Definitions were created of what minimum requirements were needed of the selected companies and respondents with the appropriate qualification and experience to speak on the subject matter. Only large companies were selected with more than R50 million of revenue from a company perspective, which had a supply chain and logistics element to their business. Larger companies were expected to significantly impact carbon emissions and their insight into how carbon emissions are managed. The large company size provided the best insights for other large emitters to adapt their business models.

The company also needed to be known to be involved in green innovation and sustainability, as defined earlier. Green innovation could include energy, fuel,

infrastructure, water, or waste initiatives that positively impact improving carbon emissions.

The unit of analysis included individuals within those businesses that had management experience with five years or more experience driving green innovation projects. Experienced participants allowed for better insights into the level of influence needed to convince both the senior directors and shareholders. These managers could also influence their direct reports to adopt the change needed to implement green innovation. The individuals also needed to be involved in sustainability, supply chain and innovation initiatives towards improving carbon emissions. These selection criteria ensured that deeper insights were gained in achieving the research objectives.

4.10. Sampling method and size

There are a significant number of companies with significant supply chain operations in South Africa. Non-probability purposive sampling was used in order to obtain the sample for testing. Judgement was employed to the sample selected to obtain the data which answered the research questions. A process was followed to select companies that focused on a sustainability agenda that could provide insights into practical ways forward for the industry. Convenience sampling was used to select the companies and their managers to be interviewed based on the researcher's network in the South African supply chain and logistics industry. Using the snowball technique, the researcher requested respondents to obtain further respondents to interview (Sauders & Lewis, 2018). A sample size of 12 interviewees was carried out to obtain sufficient information and for data saturation to be reached. In similar studies carried out in a European environment, a sample size of 10 to 15 respondents were used (Oberhofer & Dieplinger, 2014; Centobelli et al., 2017). The interviewer purposefully chose the sample to allow for sufficient and quality data to be gathered across the organisations. The researcher used his experience in supply chain to identify large companies that have an involvement in sustainability and green innovation to extract information that would assist the research process.

4.11. Measurement instrument

Interviews were conducted using a guideline questionnaire which was aligned to the research questions and sub-questions. The research questions were developed after the literature review to ensure that new phenomena emerge from the research. The

themes of the questions covered the drivers to green innovation in the South African supply chain, the practical adjustments to business models that were carried out to support the circular economy model and understanding of areas in the supply chain that green innovation could increase the environmental and economic benefits for these companies. The table below provided consistency between the guideline questionnaire, literature reference and the research questions.

Table 3: Research questions linked to the data collection tool

Research question/ objectives	Data collection tool
Research question (RQ): What are the key drivers that support green innovation and circular economy in the South African supply chain?	
SQ 1: What are the external drivers of green innovation and circular economy in the supply chain	1. Please provide an overview of your role in the company and what involvement you may have in environmental sustainability 2. Please explain your company's green supply chain and green innovation strategy 3. How has your company actually performed against the strategy? Please elaborate on actual versus targets 4. What are the biggest drivers and barriers to implementing green innovation in supply chain and logistics? Please explain each one in detail
SQ2: Which areas of green innovation in the supply chain can result in positive economic and environmental benefits	5. Please elaborate on which areas of green innovation may bring about the most significant impact to cost reduction or increased profitability 8. What scope within the value chain is there to reduce cost or waste according to circular economy principles?
SQ3: What changes (internal drivers) can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy	4. What are the biggest drivers and barriers to implementing green innovation in supply chain and logistics? Please explain each one in detail 6. How do you create the change required in the organisation to achieve the green innovation strategy?
SQ4: What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based	7. What is your understanding of the circular economy model in relation to your current business model? 9. What changes to the current business model can be adopted to bring in green innovation? 10. Reflecting on companies that have been successful in their green supply chain journey, what more could South African companies do to bring about change?

4.12. Data gathering process

Once the participating companies were selected, contact was made with the

organisation's relevant supply chain or sustainability manager to arrange an online interview. Calendar invites were used to book the date and time based on mutual discussion. The data gathering process involved using online collaboration software called Microsoft Teams to interview the respondents. Ethical approval was be obtained from the respondents by accepting the terms of the online meeting and attaching the consent forms to the meeting invite.

A request was made to the participants to record the interview, all of whom had agreed to the recording. The interview questionnaire was used to guide the interview to channel the required information. During the introduction, respondents were made aware of the purpose of the research and reminded of the informed consent form and whether they were happy to proceed. Seven of the respondents made use of the camera functionality, which allowed for an easier flowing conversation. During the questions, the researcher listened and probed for insights while taking notes.

The online setting effectively allowed multitasked skills to engage with the online respondent and use note-taking functionality that may not have been as effective in a physical meeting. The respondents' names and positions were maintained confidential throughout the research process. All interviews were transcribed following the recording to prepare the information for analysis. A non-disclosure agreement was signed with the transcription services company to maintain the confidentiality of the respondents.

4.13. Analysis approach

The transcribed recordings were summarised using Microsoft Excel tables to be able to derive themes from the interviews. Coding was used to establish the data gathered and to understand whether data saturation has been reached. Coding is a systematic process that provided focus to the data gathered and coupled with the setting of exclusion criteria, allowed for the best use of time. The exclusion criteria depended on the nature of the interviews and to what extent data was relevant (Vaughn & Turner, 2016). Data saturation was achieved by recording the number of unique codes generated after each interview and representing them graphically. These graphs have been presented in Chapter 5 under the relevant research sub-questions. Additional information received from the questions asked were collated and reported on in Chapter 5. Company reports and secondary data were used to

triangulate data from the interviews to compare against the research questions.

4.14. Quality controls

The researcher ensured that objectivity was maintained throughout the research process by not engaging in a subject bias. This was a challenge as the researcher has been within the supply chain field for many years. Controls used included open questions to allow the respondent to speak and follow an inductive approach to gathering data. During the interview process, the questions were asked from a neutral point of view in a consistent setting using the online platform.

The evidence gathered throughout the research process was objectively viewed, considering various angles and presented objectively. The researcher also ensured that the research was carried out with rigour by making insights beyond the obvious and ensuring sufficient data had been gathered to present the analysis and conclusions. The research was carried out through the detailed processes mentioned to ensure that the study may achieve replicability (Ang, 2014).

The interview setting's standardisation improved data gathering quality as all the interviews were carried out through the online platform. The online setting improved the standardisation, and video was used where possible to enhance the quality of interaction. The researcher has significant experience in the supply chain and logistics industry and was able to ensure that the interviews were directed to achieve the objectives of the research. Interviews were intended to take 40 minutes each to allow sufficient time to gather detailed answers to the proposed questions.

4.15. Limitations

Qualitative research using interviews depended on the researcher's skills in carrying out the interviews (Dilley, 2004). The nature of fewer interviews carried out using qualitative research meant that it could not reach the level of generalisation that quantitative research does (Ang, 2014). The researcher's use of judgment in terms of the sampling technique and the selection of managers to interview may have influenced the data gathered. This was mitigated by using a wide range of companies with significant supply chain operations and ideally listed companies to get a broader perspective of information.

Considering the social distancing recommendations around Covid-19, face-to-face interviews could not be arranged and hence the researcher placed appropriate online measures to ensure a similar level of effect. There were limitations in that interviews were conducted online instead of in-person. As mentioned, five participants chose not to keep their video on, which made it challenging to see expressions to comments and questions raised. The researcher had to use a voice tone to establish the participants' thinking and required follow-up questions to confirm a mutual understanding of specific points.

Data gathering was a challenge as interviewees had to reschedule interviews which meant that the planned timing was delayed. Some issues occurred during three interviews, whereby the quality of the internet connection meant that some words were inaudible. The inaudible words were reconstructed by rephrasing questions and repeating questions to the participant.

The interviewer was also not an expert in carrying out interviews, which meant there might be a limitation on the interviewing process's effectiveness. The researcher developed improved interviewing techniques by using the guideline questionnaire, reviewing books on qualitative research gathering, and improving the skill as each interview was completed.

4.16. Ethical considerations

The GIBS Research and Ethics Committee followed an approval process around ethical clearance to ensure that the research participants and the institute was protected against any harm. Clearance was obtained from the Committee before proceeding with any data collection. All participants were informed of the consent form as part of the online interview process and provided online approval of the consent form by accepting the meeting request before the interview date. The consent form indicated to participants that they would be interviewed on a voluntary and anonymous basis and that they could decline the interview at any time.

Post the interview, participants names were removed from the transcripts to ensure anonymity other than the company that participated in and their level of seniority, function and experience level. This ensured that the results and analysis maintained an ethical clearance process while at the same time, achieving the research purpose.

5. CHAPTER 5: RESULTS

5.1. Introduction

The results of the data gathering are presented in this chapter. The chapter commences by summarising the interviews and details of the participants and their companies. The data presentation is then carried out according to the research question and sub-questions that have been detailed in Chapter 3. The reason for presenting data in this approach is that the inductive nature of the qualitative methodology where phenomena may emerge.

The inductive approach to data gathering created unique codes from the participants' quotations, categorised into themes and subcategories. These are presented under the relevant research questions and sub-questions to provide a meaningful structure to understand what the participants stated in the interviews. Each theme is discussed and explained to provide beneficial insight into the context or words described by each interviewee relevant to the research area. A section has been added for each research question on data saturation and triangulation to provide an external view on the completeness and quality of data gathering.

5.2. Summary of the respondents

The below table describes the 12 participants and aligns with the sample criteria presented in the methodology section. Essential sample criteria for each participant was that they represent a large organisation in South Africa that has a significant supply chain operation. The manager is a senior in the organisation with more than five years of management experience and is involved in the functions of supply chain, innovation and sustainability. A column tabled criterion for selection is met, with additional information included such as the title of the participant and their functional area of responsibility. Due to certain organisations' significant size, a second interview was conducted within the same company to provide further insights.

Table 4: Summary of respondents

Coded name	Company	Designation of participant	Sample criteria	Functional area of responsibility
C1	Mr Price	Supply Chain Director	Yes	Manages the entire supply chain operations and logistics function for Mr Price globally
C2	Mr Price 2	Group Sustainability Director	Yes	Drives Mr Prices sustainability strategy, focus is on sustainability in the supply chain
C3	RCL Foods	Group Sustainability Manager	Yes	Drives the sustainability pillar for RCL, focused on waste, energy and water
C4	Grindrod	Commercial Manger	Yes	Oversees all commercial matters, responsible for reporting on sustainability matters to customers
C5	Grindrod 2	General Manager	Yes	Manages the automotive division, focus on developing sustainability for the business
C6	Imperial	Group Sustainability Executive	Yes	Delivers on the groups' sustainability strategy, oversees the reduction of carbon emissions
C7	KDG Logistics	Chief Technology Officer	Yes	Introduces and implements new technologies for the group, focus is on green logistics
C8	Chep 1	Group Sustainability Director	Yes	Responsible for delivering on global sustainability strategy
C9	Chep 2	Supply Chain Manager	Yes	Introduces new technologies and process improvement in supply chain. Focus is on sustainability
C10	Bell Equipment	Group Technical Manager	Yes	In charge of product remanufacture and technical services. Introduces technology to ensure remanufacturing can be achieved
C11	Toyota South Africa	General Manager: Production and Logistics	Yes	Drives sustainability in production and logistics. Focus is on reducing emissions
C12	City Couriers	Technical Director	Yes	In charge of delivering technical expertise for the group, bring in innovation to deliver on businesses sustainability drive

All the businesses had their base in South Africa and are considered large enterprises with well-known sustainability and green focus in supply chain. At the same time, these companies significantly impact carbon emissions in the supply chain, making them ideal for inclusion in the sample. Seven businesses are considered multinational businesses based on the parent, subsidiary, and associate companies' geographic presence. Five companies are listed on the Johannesburg Stock Exchange (JSE), and two are listed on global stock exchanges with a significant presence in South Africa. The remaining two companies are significant private-owned companies in South Africa that have a proven record in diving green innovation across the supply chain. This information is summarised in Section 5.4

under green innovation strategy.

The respondents provided an overview of their business, focusing on their green innovation strategy and sustainability strategy. All the business selected had a sustainability lead or a senior management individual tasked to focus on sustainability and to drive green initiatives. There was a close relationship between the functional areas of sustainability and driving green innovation amongst the companies' departmental focus.

Focus has been placed on mature businesses that have been in operation for a long time, over 20 years in South Africa. They each have adapted their business models over the years to adjust to the changing landscape of newer technologies, particularly those linked to green.

5.3. Summary of the interviews

The interview guide developed in Chapter 4 was used as the instrument for obtaining further insights into the subject matter. The interviews averaged approximately 35 minutes, with a total duration of 423 minutes for the 12 interviews. A total of 145 codes were generated, which were combined into themes and subcategories. The below table provides a reference point for the subsections and themes that conform to the research sub-questions at a summary level.

Table 5: Research sub-questions and related themes

RQ: What are the key drivers that support green innovation and circular economy in supply chain		
Ref	**Sub-question**	**Theme**
SQ1	What are the external drivers of green innovation and circular economy in the supply chain? (5.6.1.)	Competitive Advantage (5.6.1.1.) Customer perception and drive (5.6.1.2.) Reputational and Operational risk (5.6.1.3.) Legislation (5.6.1.4.) Investor (5.6.1.5.) Environment (5.6.1.6)
SQ2	Which areas in the supply chain where green innovation can result in positive economic and environmental benefits (5.6.2.)	Renewables (5.6.2.1.) Waste reduction (5.6.2.2.) Biofuels (5.6.2.3.) Water reduction (5.6.2.4.) Reusable materials in supply chain (5.6.2.5.)
SQ3	What changes (internal drivers) can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy (5.6.3.)	Sustainability strategy (5.6.3.1.) Sustainability network (5.6.3.2.) Culture and Values (5.6.3.3.) Value proposition (5.6.3.4.) Awareness and training (5.6.3.5.)
SQ4	What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based (5.6.4.)	Changing the way we collaborate (5.6.4.1.) Changing the way we measure business (5.6.4.2.)
Added data	Barriers to green innovation and circular economy in the supply chain	Linear economy infrastructure (5.7.1.) Other barriers to green innovation (5.7.2.)

5.4. Green innovation strategy

Respondents were asked whether they had a green innovation strategy in place and what did this comprise. For some companies (C2, C6), their green innovation focus was to become more sustainable to achieve a competitive advantage. Companies chose low hanging fruits to tackle environmental issues and, at the same time, achieve economic profit. Those companies that adopted sustainability initiatives as part of their strategic pillars were well-positioned to driving green initiatives. A trade-off exists between driving initiatives covering societal needs, environmental matters and economic profit to achieve sustainability. In general, when most respondents referred to sustainability, they inferred that it was green that they were targeting. Societal matters were important, but this was in most instances were separated when considering green innovation strategy.

Respondents understood the need to drive green innovation and used a project-

based approach that impacted shorter-term successes, which later snowballed into more projects of an environmental-focussed nature, which also improved economic benefits. Respondent (C6) indicated that innovation and testing were important in delivering on the strategy to work out which innovations to target first. A summary of the various strategies is listed in the table below.

Table 6: Summary of the green innovation strategy for the respondents

Coded name	Company	Size	Green innovation strategy	Initiatives introduced to reduce carbon emissions
C1/C2	Mr Price	JSE listed company.	Agile is a cost-effective business that provides the right quality products to bring about economic, social, and environmental benefits.	Renewable energy, water reticulation, reusable packaging, reverse logistics, process optimisation through supplier collaboration
C3	RCL Foods	JSE listed company.	Sustainability is a separate pillar of the strategy, focus on waste reduction, renewable energy and being water smart	Renewable energy, product technology, waste reduction, biogas
C4/ C5	Grindrod	JSE listed company.	Differentiate from competition by introducing green innovation in automotive logistics	Water reticulation, renewable energy, green buildings
C6	Imperial	JSE listed company.	Leader in green logistics and innovation in the supply chain	Fuel technology in fleet, biogas, renewable energy
C7	KDG Logistics	Large SA logistics company	Introduce green innovation in automotive logistics to reduce cost and enhance delivery performance	Electric vehicles, innovation in truck/trailer combinations, greener fuels
C8/C9	Chep	Listed globally	To be the most sustainable company in the world through implementing circular economy and the sustainable development goals	Waste reduction, renewable energy, circular business model, reverse logistics
C10	Bell Equipment	JSE listed company.	Innovation and automation in mining-related equipment and logistics	Using remanufacturing to reduce waste and maintain asset performance
C11	Toyota	Listed globally	2050 CO2 challenge to reduce emissions to zero	Hybrid-electric vehicles, greener logistics, waste packaging reduction
C12	City Couriers	Large SA logistics company	Innovate and experiment with cutting edge technology in logistics to reduce cost, emissions and enhance performance	Truck/ Trailer configuration, greener fuel, renewable energy

5.5. Measurement against green innovation strategy

Respondents added comments around how they were measured against their green innovation strategy and provided insights into large corporates' reporting mechanisms to track green innovation performance.

One of the measurements highlighted was a socio-environmental impact. The lower the socio-environmental impact of carrying on business activities in a specific geography indicates a better performance against strategy. Another respondent uses a measurement tool for supplier grading, whereby suppliers are measured using different metrics that align with sustainability initiatives and include green initiatives. This is part of a collaborative drive to extend the focus beyond the respondent and includes the broader value chain. The use of newer technologies such a GPS to measure global supply chain and logistics has improved the ability to assess environmental impact.

Measurement of strategic performance could be assessed in many ways. Listed companies highlighted that the measurement reporting for ESG (Environment, sustainability and Governance) as required by the JSE (Johannesburg Stock Exchange) and King IV reporting, which is the most widespread measurements used in business. A summary of these reports is presented in section 5.8. under sustainability reports, which is also used as supporting data to triangulate the results obtained.

5.6. Results of the main research question

The overarching research question has been categorised into four sub-questions to present the interviews' findings in a structured manner. Participants were asked about their views on the drivers towards implementing green innovation and circular economy in the supply chain. There were further prompted around the need for change from an internal company perspective to drive the change. Supporting questions to the main research question included the types of green innovation which would support circular economy principles of reducing cost and waste from the system to provide economic and environmental benefits. Finally, the participants were asked questions around the business model changes that would need to be adopted to support circular economy and green innovation in the supply chain.

Participants were free to discuss their thoughts, ideas and experiences around these questions to induce outcomes summarised and presented for analysis. This approach provided deeply insightful information from a South African perspective

5.6.1. Results of SQ1

What are the external drivers of green innovation and circular economy in the supply chain?

Respondents provided their insights as to what drivers of green innovation, in their experience will support greater adoption of green innovation in their companies' supply chain. The following themes, subcategories and codes present the summary of the data to follow.

Table 7: Themes for SQ1

Themes for External drivers (SQ1)	Subcategories	Frequency of codes
Competitive Advantage (5.6.1.1.)	Competitive Advantage	4
	Technology leader	2
	Efficiency	2
	Brand	1
Customer perception and drive (5.6.1.2.)	Customer perception of green supply	3
	Customer driven green journey	6
Reputational and Operational risk (5.6.1.3.)	Operational risk	4
	Reputational risk	2
	Environmental shocks	1
Legislation (5.6.1.4.)	Government incentives	2
	Government taxes	2
	Compliance	2
Investor (5.6.1.5.)	Investor commitment	3
Environment (5.6.1.6)	Reduce carbon footprint	2
	Share and reuse	1

The number of unique codes formed during the coding process decreased as more transcriptions were reviewed in sequence. The graph below shows the increase in unique codes as each sequential transcription was reviewed from left to right. As can be seen, there were fewer unique codes added in for this sub-question, indicating that the data acquired had some level of comparison and completeness.

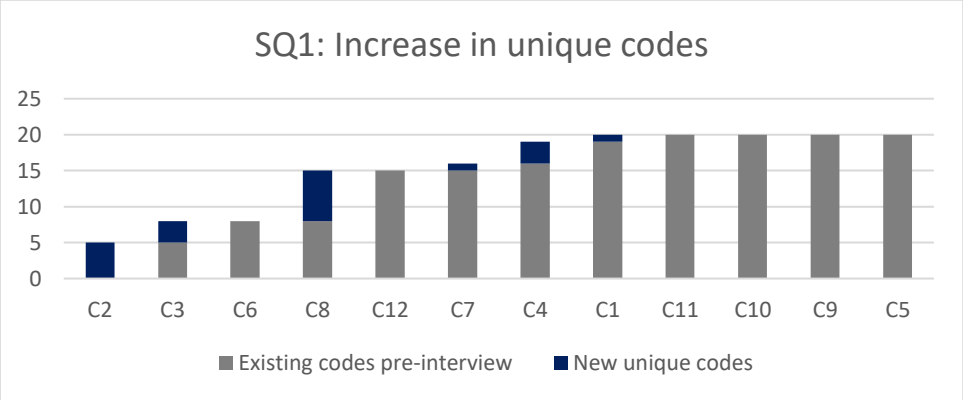


Figure 5: Increase in unique codes for SQ1

5.6.1.1. Competitive advantage

Competitive advantage presented an opportunity for driving green innovation at the participants' companies. Using technology to be ahead of the competition was necessary for some respondents. Respondent C6 mentioned,

> *"Sustainability (ESG) has become a major topic. And I think we're a bit ahead of the curve, because we are doing a lot of the stuff that some of our competitors are nowhere near where we are at the moment, without boasting." (C6)*

This was also supported by respondent C4,

> *"We need to constantly innovate and be on top of our game if we want to be the leader. But over and above that, we're obviously, constantly wanting to improve and reduce our carbon footprint." (C4)*

Competitive advantage could also be achieved through improved cost competitiveness following the implementation of circular supply chain models as experienced by participant C10, who mentioned,

> *"There's no fancy recipe in it from a strategy point. It's driven by price, so if a new component was very close to a remanufactured component, we wouldn't have been that successful, because it's all about price. So, if a customer knows that he's paying 30% less for a component that has the same warranty than a new one and should provide the same life expectation as a new one,*

you will buy a remanufactured product." (C10)

A further example of the improved cost advantage of implementing green innovation was experienced by respondent C5 from a dual fuels perspective bringing in a lot more environmentally friendly fuel into transportation.

> *"Having a truck that can do dual fuels, meaning a gas and diesel, already will be a win for us. So, that's another very big area. You know, fuel is 30% of our monthly cost. So, if we can drive that cost down, first of all, drive it down by using another fuel type at a lesser cost, it'll give us a competitive advantage." (C5)*

5.6.1.2. Customer perception and drive

Customers play a significant role in driving green innovation in the supply chain due to their high level of influence and ambition to be seen as a good corporate citizen. Customers wanted to be associated with sustainability and green in the supply chain, as mentioned by respondent C2,

> "*Our customers - funny enough, the value customer didn't really ask questions, but once you put the product in front of them they love you for it and they start thinking of you differently." (C2)*

Participant C6 went to extent of working together with customers on ways to implement green in the supply chain.

> *"When we take on big contracts like this, we sit down with a customer, because obviously, as you know, Woolworths is on that green journey of theirs and I wouldn't say they're a difficult customer, rightfully so, but on their green journey, they want their whole supply chain as well to go green. So, we sit down with them and we understand their requirements in detail." (C6)*

Customer perception also plays a large part in driving companies to increase green innovation. Participant C8 mentioned that,

> "*Look, there is a genuine interest from our customer base around*

sustainability and the benefits that we can bring, etc.", then obviously, you can imagine that generated attention internally." (C8)

Value-driven customers also question large corporates on what they are doing to improve sustainability concerns, as highlighted by respondent C1. The customer holds significant influence in creating the drive in implementing green innovation.

5.6.1.3. Reputational and Operational risk

Supply risks, particularly for energy and water has been a driver towards implementing green innovation technologies among a number of respondents. Respondent C2 mentioned,

"A key trigger actually, funny enough, was Cape Town's water shortage. As soon as Cape Town started running out of water, investors started asking a lot more questions, which was very interesting. It was almost like the trigger." (C2)

This was also the view of respondent C3 who indicated that their primary driver for green innovation in the supply chain is long-term cost risk and long-term supply risk.

Health was also added in as a risk driver, particularly as a result of Covid-19. Respondent C8 mentioned,

"It has been that companies now realize that, more than ever, we need to operate in a sustainable way, because any sort of large-scale disruption like Covid can be extremely, extremely concerning for a company to do business. So, when you think about climate change and the challenges that will impact on businesses, it will be nothing compared to the challenges we have seen with Covid"

Respondents C1 and C5 highlighted the energy and water supply risks. Respondent C1 mentioned,

"The core reason of why we went for the water purification system was not to be green and off the grid. It was to be sustainable if there's macro blackouts

or there's power shutdowns or whatever. You've got water supply issues, which is a real issue. There's Eskom, what do you call them, load-shedding. They will become blackouts. On top of that, you get climate change. Water is scarce and it's going to be more scarce." (C1)

This was supported by respondent C5's message,

"I think more and more when water supply is going to not be as available as what it is now, electricity, more and more blackouts, obviously, that we're currently having. So, the more and more that happens, I think already there's a big change" (C5)

5.6.1.4. Legislation and carbon emissions

Industrial policy to support decarbonisation is vital to create the drive within large corporates to implement green initiatives. Respondents indicated that carbon tax was not a high cost to drive change faster, but it did achieve the visibility across stakeholders of the need to become cleaner and using cleaner fuels. Respondent C3 seated,

"Carbon tax definitely illuminates the need for becoming cleaner and using cleaner fuels." (C3)

Legislation compliance also plays a part in ensuring that companies keep up with the latest in green innovation. Respondent C12 referred to compliance by stating,

"On the compliance side, yes, we do a lot of things to make sure we've got quality and legal standards. And with that comes the carbon emissions, the tax submissions and everything around that." (C12)

5.6.1.5. Investor

Investors require compliance towards green as they want to be associated with sustainable companies and have a concern for the environment. Respondent C2 mentioned,

“A number of us are listed on the FTSE4Good and the JSE SRI index and if you’re not listed, then the investors want to know why. Why are you not listed? Why are you not taking sustainability serious?” (C2)

5.6.1.6. Environment

The drive from an environmental perspective was to create solutions that reduced carbon footprint through design according to circular economy principles. Respondent C8 used the example of packaging to support this.

“As a producer, you can design a product to be dismantled and refurbished and repaired. You can design a product, for example, packaging, so that it can be dismantled and recycled appropriately.” (C8)

Carbon footprint is a significant concern as many stakeholders would be interested in dealing with companies with the lowest carbon footprint. Respondent C4 has carbon footprint at the top of their agenda in driving innovation to increase their company's perception as a green transporter.

“Our main objective is to reduce our carbon footprint. So, we look at various ways and alternatives to look and see how we can innovate and how can we drive this and become a green transporter of choice going forward in the future.” (C4)

5.6.1.7. Summary of SQ1: External drivers of green innovation in the supply chain

As a summary to SQ1, the external drivers are predominantly around competition and to support customers' expectations and perceptions. To expand on this, it is to obtain a competitive advantage to stay ahead of the technology and innovation curve and deliver on economic performance coupled with environmental benefits.

Reputational and operational risk featured high due to South Africa’s energy crisis and water scarcity issues. Companies responded to this by putting measures in place to support innovation that promoted more green technology. There was also a high degree of concern towards reputational risk by not implementing green, particularly

from association with investors, customers and employees.

Environmental legislation and carbon emissions paved the way for more awareness to create greener innovation in the supply chain, supporting circular economy principles.

5.6.2. Results of SQ2

Which areas in the supply chain where green innovation can result in positive economic and environmental benefits

Respondents were asked whether circular economy principles could be adopted in the supply chain and which areas presented the best opportunities to reduce waste and improve economic profit. The categories are presented in the table below and explained thereafter.

Table 8: Themes for SQ2

Themes for green innovation (SQ2)	Subcategories	Frequency of codes
Green innovation in supply chain	Renewables	7
	Water reticulation	6
	Waste reduction	7
	Biofuels	5
	Reusable materials	4
	Other	9

5.6.2.1. Renewables

Renewable energy presents a good opportunity to save money, and many participants highlighted the benefits. Respondent C1 fitted solar at their national distribution centre, and this proved to be quite a success.

> *"As for power, we're currently drawing, I think it's about 46%, off the roof in day-time production, because we don't have batteries. Both of them, the electricity, there's real business case where you save money. Quite a bit of money if you can do it yourself, which we've done." (C1)*

Respondent C12 mentioned opportunities to generate excess energy, allowing the

business to generate revenue from charging the tenant or the power generator.

> *"We own probably 90% of all the buildings we occupy, and the property side has found a partner that is going to help us with renewable energy. So, essentially what's happening is, all our roofs will be fitted with solar and we will, as a landlord, be supplying energy to the tenant." (C12)*

Solar technology could be extended beyond warehousing in the supply chain by fitting them onto vehicles for refrigeration as indicated by C6, which then reduces diesel consumption in vehicles.

> *"On the refrigerated units and so on as well, we're using, sort of, solar technology to power those kinds of trailers and so on as well." (C6)*

5.6.2.2. Waste reduction

There were many areas in the supply chain that respondents highlighted where waste could be reduced. For example, there could be more vertical integration to bring goods into South Africa, reducing supply chain costs. South Africa could become more competitive if it has its own capabilities to allow for more vertical integration in more industries such as textiles. The common areas of environmental initiatives across respondents included waste reduction, water security and renewable energy.

Respondent C3 highlighted that the sustainability team is looking into their entire value chain to identify outputs that are wasted or not optimal, and to introduce newer technology to reduce waste and landfill costs.

> *"We did a project with a partner, which is a bio gas plant, that literally digests all the nutrients in the waste water, producing bio gas and obviously, returning much cleaner water back to the municipality. So, that circular economy concept there, I think is a really nice example where we had a solution, but we managed to optimize it and in that, really get a value back to the business." (C3)*

Waste management was also an important component in the business at respondent

C12's company.

> *"when we did the waste management process, we went to the point of saying, "Let's separate waste. You know, plastic, paper, whatever. Let's get the guys." So, we started measuring that. We created awareness. We put posters, we put bins and then we got partners to come and collect that. Just the awareness drove, like, I need to focus on this here. And then we started measuring the waste." (C12)*

Respondent C6 used partnerships when it came to waste management to be more responsible for reducing waste.

> *"We've partnered with a couple of national waste service providers. So, onsite what we do as well, over and above from the fleet perspective on our warehouses and so on as well, we've got these service providers that have their staff on site. And then we segregate all of the waste in terms of whatever it needs to be segregated into. And then they then take it and they dispose of it responsibly." (C6)*

5.6.2.3. Biofuels

Respondent C6 noted that fuel has a major impact on the environment and forms the leading operational cost whereby there could be savings generates. Their organisation has been experimenting with greener technologies to reduce fuel consumption and emissions. New, improved methods of driver behaviour and training also contribute to optimising fuel performance and savings. Technology has been rolled out to track positioning and monitor the driver behaviour to implement corrective actions and thus improve efficiencies. There was a limit to implementing circular economy due to consumers' demands on expected fast-moving goods to the stores. This is a trade-off as it usually brings in limitation on the extent of reverse logistics possible.

> *"Our largest consumption and our biggest footprint comes from our diesel consumption. we do experiment from time to time, like, biodiesel or gas fuels vehicles at this point in time. We don't have very many on the fleet, due to the fact that there isn't sufficient infrastructure in South Africa." (C6)*

Respondent C1 explained that there is a substantial scope within the supply chain to reduce waste in packaging by introducing PCW (previously consumed waste) and recycled plastics into the supply chain. This would reduce the carbon emissions resulting from using plastics in packaging for supply chain and logistics by introducing green innovation.

> *"95% of the content of that material that's making the packet in those bags, are recycled plastics that we took. So, we said, we can't force the consumer to use our packets for reuse or bring them back and recycle. So, let's chase it from another angle. Let's just go and get rubbish plastic, okay? I don't care whose plastic it is. Go and get the plastic, recycle it, make it into pellets and put it in our bags. So, by the end of January (2021), only 5% of the content on all packets in Mr. Price will be virgin plastic. The rest is recycled stuff that we went and got out of dumps." (C1)*

5.6.2.4. Water reduction

Water reticulation has reduced the operational risk of continuous supply and resulted in more savings for the organisations. This was the view of respondent C12 when referring to their main production facility.

> *"The rainwater harvesting is definitely worth it for our facility in Richards Bay. So, that's definitely been a positive for us." (C12)*

Respondent C1 has been off the grid since they built their national distribution centre, which has produced positive benefits.

> *"We have found that with water, I think I said it to you guys on the day, we've been off grid with water from the day we started. Bang. We've never, ever used water except for, I think, two or three occasions where we actually used council water, because we were washing the tanks. Other than that, we capture off the roof, we recycle and we push back into the DC" (C1)*

5.6.2.5. Reusable materials in supply chain

Reusable packaging in the supply chain promotes both environmental benefits and

significant cost-saving opportunities, according to respondent C9.

> *"On the plastic side, so on the crates that we have in the business, the agreement there with our supplier, with the crates that are damaged, they take that back and they re-grind the material and use that in the new crates that we purchase. So, yeah, just the whole reuse principle from there." (C9)*

Reusing road tyres for alternate purposes also makes sense for respondent C6 as this prevents old tyres from being dumped at landfills.

> *"Some of the tyres are shredded and it's used for road making, you know, for stabilising the road. Some of it is used in the cement industry for fuel in the industry and then the steel is taken out and reused for other purposes and so on." (C6)*

5.6.2.6. Summary of SQ2: Determine which areas in the supply chain where green innovation can result in positive economic and environmental benefits

The innovation that can be incorporated in the supply change ranges from renewables, water reduction, waste reduction and reusable materials. Most respondents had adopted renewables and water reticulation into their strategy due to the operational risks they face. This integrates quite well into the SQ1 on external drivers, particularly relevant South Africa, to secure long-term operational risks. Participants related their experiences of their green journey depending on how mature the business was in implementing their green strategy to relate what has worked well for their companies. The data is presented according to the categories of innovation that result in positive economic and environmental benefits.

5.6.3. Results of SQ3

<u>What changes can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy</u>

Respondents were asked about the changes that can be done internally within their organisation to make the change towards implementing green innovation and circular

economy in the supply chain.

Table 9: Themes for SQ3

Themes for Internal drivers (SQ3)	Subcategories	Frequency of codes
Sustainability strategy	Separate sustainability function	6
	Leadership and strategy	7
	Green roadmap	2
Sustainability network	Start at senior management level	4
	Business champions	2
	Association	3
Culture and Values	Experimental culture	4
	Sustainability culture	4
	Doing it for the right reasons	5
Value proposition	Efficiencies	2
	Financial benefit	3
Awareness and training	Awareness	3
	Training	1

The number of unique codes formed during the coding process decreased as more transcriptions were reviewed in sequence. The graph below shows the increase in unique codes as each sequential transcription was reviewed from left to right. Fewer unique codes were added to the transcriptions, which provide some insight as to the comparability and completeness of data gathering for this sub-question.

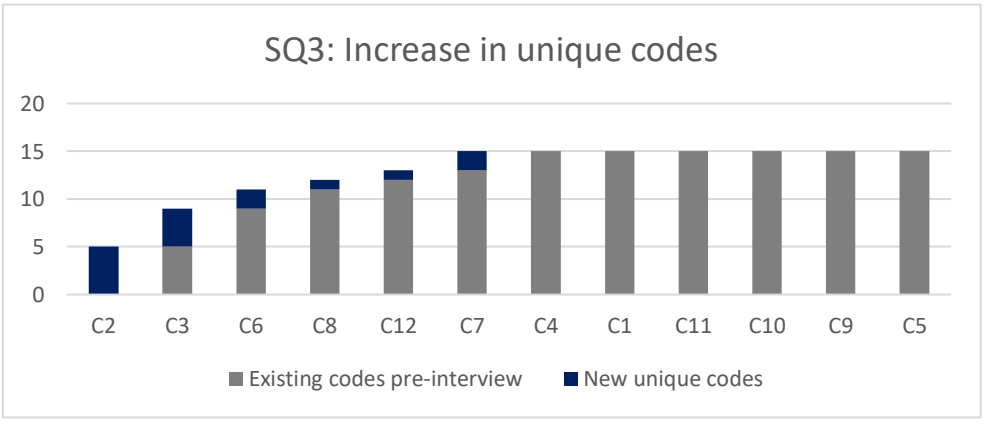


Figure 6: Increase in unique codes for SQ3

5.6.3.1. Sustainability strategy

Having a strategy and long-term roadmap that includes sustainability explicitly as a pillar proved to be a main internal driver towards targeting and achieving goals. In terms of long-term strategy, the following notable quotes from C6, C11 and C3

indicate that green innovation and sustainability is something deliberate that is planned in terms of a longer-term vision.

> *"There's a strategic imperative to be as green as possible and we're trying our level best in terms of trying to get there." (C6)*

> *"The drivers, I think, it comes from global Toyota. So, this 2050 challenge has been set a few years ago by the President and every affiliate has adapted it." (C11)*

> *"If we want to become the most responsible or most amazing food company in 20 years from now, what is the stuff that we have to do now to, you know—not to do anything that's going to withhold us from getting there." (C3)*

There was also the addition to the long-term strategy in terms of how this will be achieved. Having a green roadmap allows companies to formulate precisely how the business will charter the green journey. Participant C7 explained it well by mentioning how simple measures can put a plan into action.

> *"What I found is that a lot of the stuff we do are, actually, fairly simple, basic, everyday things that we applied and it's just doing it in a systematic way that guides you in a direction if you have the data set. So, one of the things that I'm trying to achieve is, and I'm halfway there now, is to put a book together that offers road transport operators a paint by numbers approach to achieving sustainability." (C7)*

Management support of sustainability and including it as a separate pillar in their strategy were common across several respondents. Elevating the sustainability function's position to be included as a separate function and structure in the organogram and linking that to a strategic pillar of sustainability made the message of sustainability clear throughout the organisation. Implementing and monitoring green innovation became more manageable for those creating the change across the organisation. This was highlighted by respondent C6 in the quote below.

> *"the biggest plus I had is that I had the support of the board and the Exco. Without them, this couldn't have been possible, because if they didn't support*

it, it would have been very challenging."

The titles of the individuals mentioned earlier in this chapter also support this point. Titles include Sustainability Head, Sustainability Executive or Group Sustainability manager. These titles add the comments of the seniority of the position and the point that sustainability is viewed as a separate pillar in the organisation to enable sustainability initiatives across the business functions.

5.6.3.2. Sustainability network

Setting up task teams to include middle-level managers to create the proper influence towards driving sustainability initiatives. The success of these interventions built momentum amongst the senior management teams to support and adopt the change. It is more effective to create the change at multiple levels, not only within corporates but at an industry level. All the efficiencies and savings are measured to be able to create success stories and promote change efforts. Respondents comments in this regard are mentioned below.

> *"The best traction was at a senior management level at a divisional business level, where those champions, it was within their sphere of influence to start shifting and doing things differently. And they bought into the principle of sustainability, they bought into the fact that there could be efficiencies and cost savings and, I guess, doing the right thing and making sure that we invest into a sustainable future." (C2)*

> *"Sometimes even our own people that work for us are not fully convinced. So, you sit down with them and you convince them this is where the world's heading to, this is the benefits of it, definitely more economical and you often find that you first have to convert your own people and then when they are converted, they help you advocate this then. But word of mouth is probably, the most powerful thing, so you convert one or two customers." (C11)*

Having a sustainability network that extended beyond the organisation also allowed for better drive internally to support green. These networks may be in the form of associations that can assist the company in achieving its goals. Respondent C3 elaborated on their association below.

"We started off with our sustainability drive in 2016 and we literally got together key stakeholders from within our leadership team and had a session with— we involved the Cambridge Institute for Sustainability Leadership" (C3)

Respondents clarified that sustainability teams within the business could not work in isolation as they need to get the people within the organisation to accept change. It has to be a systemic shift to change the organisation's culture towards adopting more green initiatives. The individuals are driven by measurements set through the strategic initiatives and share knowledge amongst the task teams setup to gain the synergies needed.

5.6.3.3. Values and Culture

Developing the values in the business to understand the importance on green innovation was key to getting the traction needed. Respondents worked on developing their sustainability culture to care for communities and the environment (C1, C2, C3, C8 and C12).

"When we started talking about the values of the business and about partnership with our suppliers and caring for our community and our environment, that was the driver that actually got the attention at the time. "The shift that we've seen in the key drivers, I'd say, over the last two years has been investors and consumers". (C2)

By creating the culture and values internally, other stakeholders began to pursue green innovation and sustainability. Values may be seen as the initial steps a company may undertake to develop a green innovation strategy, which then later sets the tone for consumer and investor buy-in and expectation of the company to continue innovating on their green journey. Customers are interested in seeing both social and environmental impacts develop with a brand that improves reputation and association. Respondent C1, C3 and C5 highlights below the importance of having the right values internally to support the change and not just for public advertising.

"Mr. Price has always just been that company that says, "You know what? We're going to do the right thing regardless of whether we want to advertise

it or not." (C1)

"We obviously try and do it first and foremost for the right reasons. So, in terms of, do we believe that something is long-term sustainable or not?"

"I think it's one of those things where you have to be a good corporate citizen nowadays and be seen to do the right things. But I think it's also for the right reasons." (C5)

Respondent (C12) mentioned that green innovation is promoted when leaders allow personnel in the company to innovate without interference, concern over the losses that may be incurred, or negatively impact the individual's career. Idea creation is supported by the top management structure to the extent that funding and autonomy are provided to the individuals involved. This freedom to innovate creates a culture of experimentation in the organisation, which supports going green.

5.6.3.4. Value proposition

Respondent (C3) highlighted that leaders support green innovation much easier if there is a commercial business sense around achieving the company's financial and shareholder targets.

"the main driver for a lot of these initiatives are, do they make business sense first and foremost?" (C3)

The green innovation that is implemented must have a standalone economic business case to get the support of the management team and shareholders. The environmental value proposition is not always seen as the primary reason to get internal buy-in towards green, although changing to some extent with the points on culture and values mentioned above. Respondent C8 mentions having a solid value proposition to the customer, particularly around the cost to support the sustainability drive.

"The key component of our service to our customers is the fact that we can provide value at an acceptable cost, right? So, we had a strong value proposition because we could generate efficiencies, reduce cost and optimize

performance." (C8)

5.6.3.5. Awareness and training

By creating more awareness and training, companies were more likely to make any change towards green more successful. Respondent C7 mentions that awareness, coupled with training and monitoring, will allow for change to occur, whereby the supply chain role players become more responsible for the impact on carbon in the environment.

> *"We need to start with some sort of awareness and education intervention. And then you need to create some sort of dashboard, through which this can be tracked and improved on and then even, maybe, reported on. Because as an industry, we need to start taking responsibility. If you look at some simple stats, like, 50% of all the man-made CO2 in the planet, 50% of all the man-made CO2 in our atmosphere was created in the last 30 or 40 years." (C7)*

Respondent C4 stated that its more than just training as there is a degree of influence needed to change people minds around green.

> *"It's actually a selling, not a telling, job. It's an education. It's an understanding. it's going to have to be a selling process. And it's going to take some convincing" (C4)*

Training is also required from a technical perspective, based on the new technologies implemented to ensure that the value propositions are achieved. Respondent C6 had implemented optimisation technology on their fleet to allow for improved fuel usage, thus reducing emissions.

> *"There's extensive driver training and they're trained by our driver trainers, as well as the OEM's send their own driver trainers as well. So, we try and get as much maximum optimisation for more drivers as well before they get onto the truck as well." (C6)*

5.6.3.6. Summary of SQ3: Internal drivers of green innovation and circular economy in the supply chain

In summary, the themes to consider when looking at the internal drivers of change towards implementing more green innovation range from strategic perspectives of having a long-term vision in mind that support sustainability. Identifying sustainability as a strategic pillar and placing resources within an organisation structure that are competent and capable to drive change. The sustainability leads within an organisation however cannot work on their own and need to facilitate awareness, training and drive the culture change needed within the organisation. Companies that seem to have been successful in this were open to creating an experimental culture that would engage the new technologies and learn from others. These business champions would advocate and promote green across the organisation, thus creating the drive to execute on strategy.

5.6.4. Results of SQ4

What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based

Respondents were asked what changes could be adopted in the current business model to support changes in the supply chain towards green innovation. The key themes are presented in the table below and discussed thereafter.

Table 10: Themes for SQ4

Themes for business model changes (SQ4)	Categories	Frequency of codes
Business model changes	Collaborate across the supply chain	8
	Change business measurements	5

5.6.4.1. Changing the way we collaborate

Supplier collaboration was highlighted by respondents (C2, C3 and C8) to be an essential part of extending green innovation beyond the company itself. Having a procurement department aligned with strategic initiatives around green and sustainability allowed for the engagement with the suppliers to be more robust. The ability to control a supplier to reduce carbon emissions is related to the respondents' level of dominance over their suppliers.

Respondent (C1) stressed the importance of supplier collaboration in the supply chain, particularly in dealing with seasonality, whereby a retailer could use facilities from other industries such as citrus for their warehousing space non-peak months for citrus. This space availability ties in with the peak demand of retail during Christmas, which is a win-win for both parties and at the same time optimises the supply chain and removes waste. The respondent also provided another example of collaboration to reduce carbon emissions whereby the retail market that would need delivery of product from Durban into Johannesburg, converted their truck trailers to make alternate use for the empty return leg from Johannesburg to Durban. They realised that FMCG industry players based in Johannesburg could alternate truck trailers to transport their palletised goods and collaborated cross-industry to benefit from a continuous two-way flow, improving efficiency and reducing waste.

> *"Citrus fruit doesn't grow this time of the year, the exports are dead low, so the chilled warehouses or the warehouses that are there for export fruit are standing empty. So, we went to one of these companies and we said, "Listen, your dead time is our busy time, but your model allows you already to absorb the costs of your warehouse, etc., so can we come to you guys, we strike a deal on a cost", which is really a cost recovery for him rather than a margin driver. In effect, it is a margin driver in the end, because he never knew he was going to do that." (C1)*

Respondent (C2) indicated that customers' behaviour patterns align with more circular principles. There needs to be a mindset of producing to limit waste. The current business model of expecting increasing and continuous growth is one reason there is a high level of waste.

> *"Our biggest key focus going forward is going to be the actual value chain, where our supply chain sits and what the impact is in that supply chain." (C2)*

One of the respondents (C3) highlighted that innovation in the business model extends to financing from a South African perspective as it allows for the newer technology to be packaged within the budget of companies. An example of this was for renewable energy products to take on a rental model whereby the savings generated from electricity costs could be allocated towards settling the rental payment. Parent companies were used to stand as guarantor for the lease period,

which could be tied back to the payback period of the technology.

> *"We've been driving the group solar rollout, which is maybe not, it's definitely not innovation anymore, because solar's pretty established technology. But we found a clever way together with our main shareholder, Remgro, to really drive an efficient business model, which is more of a solar lease model where, you know, rooftop solar is basically leased from a third party and there's operational savings without the initial cash flow of investing into solar." (C3)*

Respondent C11 also supports collaboration as key in changing the business model, however, does highlight that this is no easy task.

> *"Between us and our suppliers, I think we've pretty much gone a long way. Because we've got now dedicated returnable bins and returnable skids per supplier and those are back and forth basis. But I must tell you, it's not so easy because the logistics system of palletising and sending the right bins to the right supplier is a big challenge for us." (C11)*

Creating business models that bring in other partners across the value chain in the circular economy allows for both improved collaboration and sustainability. Respondent C2 highlights the point of extending collaboration across the value chain

> *Our biggest key focus going forward is going to be the actual value chain, where our supply chain sits and what the impact is in that supply chain. (C2)*

5.6.4.2. Changing the way we measure business

Respondents had the view that the current business measurement systems needed to be changed. These changes involved the way suppliers and the business were measured internally, to include more environmental and social measures and having the ability to track them. Respondent C2 developed a measurement tool to grade suppliers to incorporate the additional metrics.

> *"'We've developed a measurement tool, what we call the supply grading tool, that we've built where we measure our suppliers on different metrics and we're actually developing that scorecard more broadly now. Well, we're now*

building in social and environmental metrics as well to measure our supply chain." (C2)

Including these metrics as part of commercial tender processes is an effective process change that will ensure that suppliers adhere to green changes in the value chain mentioned by respondent C3.

"When we go out to the market, for instance, for a packaging tender, there would be a section on sustainability in there with regards to, you know, packaging materials, makeup, requirements for reporting and all of those kind of things that just assist us in judging the impact of whatever the supplier offers us." (C3)

The inclusion of new measurement systems may also involve bringing in technology to support the accurate management and tracking of these measures. Using smart metres is a way to automate these measurement changes, thus ensuring less manual intervention and using systems and processes to achieve the objective described by respondent C12.

"Smart metering that is already being done in the newer sites. It's being retrofitted in the older sites. So, firstly we have accurate data on time, so we will understand the water consumption and the power consumption at the different sites. That's been done and that then comes with sensors to understand lighting, ambience. So, there's a whole big project going around making the whole business smarter." (C12)

5.6.4.3. Circular infrastructure

The supply change design needs to incorporate more circular infrastructure upfront during designing products or sourcing to ensure that circularity can be achieved. Barriers to circular supply chains are created when infrastructure is setup upfront using linear based approaches. Respondent C8 clarified this point below.

"if you want to reuse, if you want to upcycle, if you want to refurbish, you know. I don't know if you've seen the famous butterfly diagram. You have all of those circles that go back, right? In a linear model, those circles don't exist. And

funny enough, what we do as a business is actually one of those circles. It's getting products back from their retailer back into the manufacturer" (C8)

5.6.4.4. Summary of SQ4: What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based

In summary, the participants explained the innovations and drivers a lot easier than explaining changes they could see being brought into the business model. The changes they brought forward was that the value chain collaboration plays a prominent role in implementing green initiatives. This is because many decisions in achieving circular supply chains are made during supply chain design. Through collaboration, circular principles could be achieved even with role-players that were not necessarily in the same industry, as evidenced through the citrus and apparel retailer quotation.

Measurement plays a part in being able to track progress on green initiatives undertaken. It is also important to include environmental and social measures into the supply chain space, which drives more comprehensive implementation of green innovation and circular economy principles.

5.7. Additional findings

<u>Barriers to green innovation</u>

While specifically not addressed in the research question and sub-questions, respondents were asked their views on barriers as this may shed more light on the difficulties in achieving the drive towards green innovation and circular economy in the supply chain.

Respondents expanded on the drivers of green innovation in the supply chain by adding barriers they thought may be faced.

5.7.1. Linear economy infrastructure

The infrastructure in South Africa suits a linear economy rather than a circular one.

Respondent (C6) mentioned that the fuel supply infrastructure in South Africa is not compatible with European standards, which makes it a challenge in implementing green initiatives.

> *"In South Africa, the oil refineries, basically, Engen and so on, to convert to 10 ppm would cost the industry around 30 billion (Rand). And that sum was about four years ago, so that cost has obviously escalated. Now, for them to do that conversion, they think they don't make enough margin for them to be able to convert those refineries to a 10 ppm. So, the government obviously doesn't have money to do that either. So, we're stuck in this conundrum at the moment. That puts a bit of a restriction in terms of us modernising our fleet to do the latest technology fleet" (C6)*

Respondent (C8) also supported this barrier and mentioned that their business adopted a circular business model. This was due to their business being aligned with circular flows and reverse logistics. Other industries are challenged when it comes to aligning a circular business model when its infrastructure and value chain have a more linear-based model.

> "*One of the biggest barriers to the circular economy is precisely, you know, the linear infrastructure, the linear supply chain. The supply chain is linear. There's no question about that. All of the products go from one place, from A to B. But how many products actually go from B to A? These reverse logistics networks." (C8)*

5.7.2. Other barriers to green innovation

Other barriers mentioned include technology adaptation to South African requirements, cost of implementing new green technology, trading off speed and efficiency with more friendly reverse supply chain loops and funding towards green technology. Some of the quotations are reflected below that support the thinking towards other barriers to green innovation.

> *"Innovative (green) technologies have not been proven in South Africa or there's no local example, for instance, that you can just walk up to and say, "Well, did it work here in South Africa or not?" Because as we've also learned,*

you know, a lot of these newer technologies often just is not that easy to implement in South Africa due to many, many reasons" (C3)

"In the circular economy, as opposed to, let's say, the linear economy, there's big upfront investment. But there's big payback downstream, where a lot of people want to benefit now. They don't want, necessarily, to wait. (C8)

"we try as much as we can to assist in the circular economy, but there are challenges and there's no excuse about it. It is what it is. It's not a simple thing. There's certain things that you can do in a circular economy. There's some things that you can't, unfortunately. And the bulk of our kind of work that we do is fast moving goods, kind of, stuff as well. (C4)

While the barriers are noted, it is interesting to note an opposing view that the cost barriers to green innovation are more of a perception and that there are simple efficiencies that can be carried out innovatively without the high cost. As indicated by respondent C7 and C4,

"the biggest barrier is paradigm. So, many people believe that green is expensive, and innovation has got technological barriers to performance. So, just the whole way that the thing's described, it's described as something that is insurmountable or something that other people can do". (C7)

"The biggest barriers are mindset. The biggest barriers are getting people to understand and getting people to buy in on why it's important and why it's critical for the future. Because most people, when they hear about something, they say, "What's in it for me?" And if they can't see an immediate return on that, then they switch off." (C4)

5.8. Sustainability reports

Reports for Grindrod, Imperial, Mr Price, Toyota, Chep, Bell and RCL foods which cover 83 percent of the sampled companies, were reviewed as secondary data to add support to the data gathered. Some of the key findings of these sustainability strategies are presented below:

Table 11: Summary of data obtained from company reports

Coded name	Company	Green innovation driver	Green innovation focus	Carbon emission comment	Reference
C1/C2	Mr Price	Focus on green innovation, Compliance with SDGs, value chain development	Renewable energy, recycling packaging, sustainable cotton	9% reduction in carbon emissions from 2016 levels	(Mr Price, 2020)
C3	RCL Foods	Reduce dependency on natural resources and reduce the impact of climate change. Adopting circular economy principles	Energy from renewable resources, reduce, reuse and "create" water, waste free business	7% reduction in carbon emission from 2016 levels	(RCL Foods Limited, 2019)
C4/ C5	Grindrod	Align with international best practice, Carbon Disclosure Project and legislation compliance	water, electricity and fuel consumption	10% reduction in carbon emissions from 2015 levels	(Grindrod Limited, 2019)
C6	Imperial	Clients request less emission-intensive products and environmental data performance. Key risk is climate change and legislation	Fuel-efficient vehicles, water conservation, green buildings	11% reduction in carbon emissions form 2018 levels	(Imperial Logistics, 2019)
C8/C9	Chep, a Brambles company	Circular business model, innovation and collaboration in supply chain	Renewable energy, zero waste to landfill	18% reduction in carbon emissions from 2015 levels	(Brambles Limited, 2019)
C10	Bell Equipment	Regulation compliance, operation risk, cost reduction	Renewable energy, wate harvesting, waste management	No data	(Bell Equipment, 2019)
C11	Toyota	Align with global SDG, zero carbon emissions by 2050s, value chain collaboration	Minimise water, recycling technologies, zero emissions for new vehicles and plants	4% reduction in carbon emissions from 2017 levels	(Toyota Motor Corporation, 2020)

Listed companies are required to produce sustainability reports annually as part of their compliance to the JSE. Respondents highlighted that their reports might provide more insight into the research area, corroborating the results. The data from the company reports present a similar picture as to the comments received from the participant interviews. There is alignment in terms of the drivers for green innovation

as well as the technologies being implemented. The companies reflected an overall improvement in carbon emissions over the last few years following their green and sustainable strategies. They also continued to improve their share prices and profitability over this time. A number of the respondents had already embarked on a circular economy journey towards implementing circular principles in their strategy.

5.9. Summary of results

The summary of the 12 interviews conducted provided rich insights into the drivers of green innovation and the circular economy in the South African supply chain. The companies selected allowed for significant insight into some of the major supply chain organisations in South Africa particularly around their sustainability strategies. The participants were senior in their organisations to provide insight into effective strategy and what external and internal drivers have promoted the implementation of green innovation.

The key external drivers were mainly around competitive advantage to use green innovation to stay ahead of the competition and position the company into the future. The customer played a crucial part in driving green innovation due to the perception of wanting to be associated with green suppliers or their strategy of achieving green targets and reducing carbon emissions.

Some of the green innovations that provided the companies positive economic and environmental benefits were in the space of renewables, waste reduction, biofuels and water reticulation. These innovations also supported a reduction in operational and supply risk due to inherent conditions in South Africa around load shedding and water scarcity.

Internal drivers were principally around the need for a sustainability strategy around driving a long-term vision and keeping sustainability as a separate pillar of the strategy that is resourced appropriately. Sustainability cannot be carried out alone, and there needs to be a network within the organisation of influential managers to support the cause of going green and play the role of business champions.

Some of the business model's changes would need to be more around collaboration beyond the value chain to seek opportunities that could close loops in the circular

system. This is one of the ways to combat a barrier to green around linear infrastructure. There were also findings around changing how businesses are measured and including environmental and social requirements in the supply chain tendering process.

6. DISCUSSION OF THE RESULTS

6.1. Introduction to discussion on the research question

Chapter 6 provides an in-depth analysis of the findings presented in Chapter 5 on the drivers of green innovation and circular economy in the South African supply chain. This analysis considers the literature review from Chapter 2 on the latest research on green innovation and the circular economy in the supply chain. The structure of this Chapter aligns with the research questions and sub-questions from Chapter 3. This is presented in the table below to link the research themes and categories from participants' data to the research questions.

Table 12: Research questions linked to themes and categories

RQ: What are the key drivers that support green innovation and circular economy in supply chain		
Research sub questions	**Categories**	**Themes**
Sub question 1: What are the external drivers of green innovation and circular economy in the supply chain	Competitive Advantage Technology leader Efficiency Brand Customer perception of green supply Customer driven green journey Operational risk Reputational risk Environmental shocks Government incentives Government taxes Compliance Investor commitment Reduce carbon footprint Share and reuse	Competitive Advantage (5.6.1.1.) Customer perception and drive (5.6.1.2.) Reputational and Operational risk (5.6.1.3.) Legislation (5.6.1.4.) Investor (5.6.1.5.) Environment (5.6.1.6)
Sub question 2: Which areas of green innovation in the supply chain can result in positive economic and environmental benefits	Renewables (5.6.2.1.) Waste reduction (5.6.2.2.) Biofuels (5.6.2.3.) Water reduction (5.6.2.4.) Reusable materials in supply chain (5.6.2.5.)	Green innovation in supply chain

Research sub questions	Categories	Themes
Sub question 3: What changes (internal drivers) that can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy	Separate sustainability function Leadership and strategy Green roadmap Start at senior management level Business champions Association Experimental culture Sustainability culture Doing it for the right reasons Efficiencies Financial benefit Awareness Training	Sustainability strategy (5.6.3.1.) Sustainability network (5.6.3.2.) Culture and Values (5.6.3.3.) Value proposition (5.6.3.4.) Awareness and training (5.6.3.5.)
Sub question 4: What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based	Changing the way we collaborate (5.6.4.1.) Changing the way we measure business (5.6.4.2.)	Business model changes towards circular economy in supply chain

6.1.1. Discussion on SQ1

<u>What are the external drivers of green innovation and circular economy in the supply chain?</u>

Introduction to discussion on SQ1

The participants provided good insight into the external drivers of green innovation and circular economy into the supply chain. It is important to understand how these insights support the current literature to bridge the perspectives of large companies in South Africa to what is driving green from a global perspective. The literature of circular economy in the supply chain has been expanding in recent years globally, and it is important to understand the external drivers and to document these for more companies to implement green.

Competitive Advantage

The participants defined competitive advantage as the ability to extract more efficiencies and cost reduction through implementing green innovation. Many participants benefited economically by improving their efficiencies and costs, which

gave them an edge over their competition. Govindan and Hasanagic (2018) supported economic growth improvement and improved efficiency in the supply chain as a key driver. They added to this by stating that the economic benefit of driving circular economy in the supply chain is also about the potential to increase the value of products. Increased value of products coupled with the decrease in costs has potential to be a margin leverage for companies to achieve improved growth.

Micheli et al. (2020) stated that the competition serves as a driver to green and economic benefit as it encourages production efficiency and better customer performance. In South Africa, competitive advantage ranks highest in the external driver theme as there is a greater focus on overcoming competition in a challenging macroeconomic environment. Companies are continuously seeking newer ways to improve profitability. Achieving increased profitability and going green at the same time is seen as a double benefit. The increase in the value of products or improvements in efficiencies and costs all contribute towards improved profitability.

Genovese et al. (2017) mentioned that sustainable supply chains are imperative in strategy and driving competitive advantage. This is achieved through integrating environmental responsibility into the production, purchasing, and logistics systems that underpin the supply chain to reduce negative impact. The participants supported this view of green as an imperative to strategy and that the supply chain and green innovation are critical in the drive towards achieving competitive advantage. Competitive advantage is aligned to the research and can be included as an external driver for South African companies to adopt.

Customer perception and drive

Soewarno et al. (2019) attributed green innovation external drivers to include market demand for greener products. This is similar in some ways to the participants' experiences and comments. The market demand for greener products is aligned to the customer drive and perception category, whereby customers are changing to more greener products due to changing end-customer demands. Companies align with market demand forces to gain additional growth and provide fit for purpose products and services.

Sustainability and green have a knock-on effect from customer to supplier across the value chain. The view on customer pressure being an external driver was also supported by Centobelli et al. (2017) and Tran et al. (2019). Customers want to deal with companies that support green and look to achieve a reduction in carbon

emissions. Customer perception of supply chain companies plays an integral part in the supply chain for more companies adopting initiatives towards reducing carbon emissions and “to be” and “to be seen to be” aligned with green. Customer perception and drive is aligned to the research and can be adopted in a South African perspective to increase the drive for green.

Based on the discussion from participants and in the literature, customer drive and brand value ultimately take over legislation because customers want to know when and how companies will grow their green journey.

Reputational and Operational risk

While competitive advantage ranked highest as a theme, it must also be considered that a number of the companies are carrying out green innovation to protect their operational risk of carrying out business in South Africa. There may be a consideration on the rising costs of electricity and water, that green provides companies with a hedge against future cost increases that is government-administered and beyond their control.

The literature does not specifically highlight risk as an external driver. This seems unique to a South African context due to issues around the stability of power supply and water scarcity. South Africa has had constant issues with interrupted power supply for more than ten years, which has resulted in companies seeking to de-risk their businesses by implementing innovation to secure their supply. Reducing renewable energy prices makes it beneficial for companies to invest in technology to stabilise the electricity supply. Water harvesting and water reticulation have also featured prominently across participants to use water more smartly. Newer innovations are being sought in these areas to provide companies, and their investors comfort around the stability of these critical resources needed in the business's supply chain and operations.

Participants also highlighted reputation as a risk due to reputational risk and support for companies that are not setting targets or complying with sustainability. Based on this insight, South African companies are aware of their position in impacting the environment negatively and are conscious about actively managing risk to the business.

The health risk was mentioned by one participant (C8) around the issues faced following Covid-19. The point is crucial as it emphasises that green in the supply

chain is important for an organisation, social risks that can have an external threat that needs to be addressed. Covid-19 placed a strain on supply chains, which impacted global product flows. Bressanelli et al. (2019) mention that the ultimate aim of circular economy is sustainable development. The social aspect of sustainable development is not seen directly through circular economy models. Instead, it seeks to address green and economic improvement with the potential to improve social aspects of sustainable development. Operational risk is an addition to the research and one that is relevant for companies in South Africa to consider and adopt.

Legislation

The Department of Environmental Affairs (2020) had issued updated guidance on carbon emissions as a mechanism to encourage greater compliance with environmental legislation. This legislation was intended to support green innovation towards reducing carbon emissions. While participants felt that this created a drive, the cost of carbon emissions taxes did not create the change across the organisations as intended. Participants felt the government could do more to create legislation that balanced incentive and penalties towards green.

Micheli et al. (2020) identified that larger companies adopted environmental regulation to improve green positively in a global study. In other countries globally, legislation featured as a key driver due to their government's support or penalties imposed on reducing emissions timeously. Some authors in the literature review highlighted legislation as key in driving green innovation in the supply chain (Govindan & Hasanagic, 2018; Soewarno et al., 2019; Centobelli et al., 2017). South Africa has the complex task of introducing legislation towards green but at the same time balancing economic growth using its primary natural resources towards growing the economy. That being said, participants did acknowledge that the introduction of carbon emissions has created more awareness, especially around the compliance needed to go with carbon reporting.

From a global perspective, the trends in green regulation have been a shift towards greater carbon accounting and carbon border taxes. This may have the impact of placing more regulatory pressure on South African companies trading in those regions.

Investor

Investors into South Africa consider perceptions towards green in their decision to

commit to investing in companies. These perceptions have a knock-on effect on companies wanting to please investors and hence see this as a drive towards aligning with investor expectations on driving green. It was not specific from the participants whether such investors are local or global. Considering that most of the companies interviewed were JSE listed, both local and overseas investors are included.

The expectation from shareholders is that companies should be driving improved green credentials in supply chain. In a developing country like South Africa, there is an ambition to create local and foreign investment drive. As such, larger organisations are more inclined to give shareholders comfort around improving their carbon emissions. Centobelli et al. (2017) supported the point that larger organisations are more inclined to drive green innovation.

Abbasi and Nilsson (2016) mentioned that a barrier to investment commitment is technology development, regulation, and customer priorities. This ties in into the comment by the participants on technology adaptation in South Africa being a barrier. Further, the participants also supported that investor commitment was difficult to achieve due to regulatory uncertainties in a developing world context. Investors need to be kept at the top of mind by South African organisations as they provide access to funding that supports the drive to green innovation in the supply chain. Easing the way of doing business, having supportive legislation, and aligning with customer priorities will support the increase in investment in South African companies.

Environment

From an environmental perspective, participants wanted to be associated with green and not involved in “dirty industries”. There was a drive to be a leader in green technologies and to reduce carbon emissions. The environment became a key part of product design, equipment purchasing and implementing share and reuse models. Companies wanted to distance themselves from being considered take, make, and

dispose of companies that followed linear principles and instead be associated with sustainable and circular supply chains.

Figure 7: Results of SQ1

Conclusion on the discussion of SQ1

The external drivers highlighted by the participants are ties to that experienced by other organisations globally. The key differentiators were operational risk and investor commitment which are more unique to a developing economy context. Long term supply is key for getting local and foreign investment, and companies see this as a high-level priority in their strategies to bring in the innovation to de-risk supply of water and electricity in particular. The cost-benefit of green technology has supported that the risk can be closed off using technology that supports green and at the same time improve investor confidence in dealing with environmentally friendly companies that are stable in their electricity and water supply for the longer term.

6.1.2. Discussion on SQ2

<u>Which areas of green innovation in the supply chain can result in positive economic and environmental benefits</u>

Introduction to discussion on SQ2

Participants explained which innovations resulted in positive economic and environmental benefits, which supported green innovation and circular economy in the supply chain. The importance of this question was to establish which green innovations work in a developing economy context. What is inferred from the external driver analysis is that the competitive advantage from the new technologies associated with green is vital to warrant investment by companies. This means that green technology must meet both positive economic and environmental benefits criteria, other than when it is for operational risk requirements.

Analysis of SQ2

Huang et al. (2017) motivated that green innovation positively impacts economic, environmental, and competitive performance. The majority of participants had implemented green innovation in some way towards improving both economic and environmental performance. The most familiar green innovation implemented was renewable energy programs across their business. Solar panels proved effective in reducing cost and was a cleaner way of generating electricity. Water harvesting was introduced to reduce operational risk around the supply of water during periods of drought. Water harvesting also had some financial benefit and allowed for a more innovative way of using water. Waste reduction proved to be the most significant potential area in the supply chain, adopting circular economy principles. The reuse of packaging presents an opportunity for companies to adopt a share and reuse model through returnable packaging.

Introducing newer technology is essential to allow for more ways to use waste better. Technologies in fuels are also developing rapidly by introducing dual fuels to allow for cleaner natural gas to complement diesel-fuelled engines. In South Africa, the slow movement of legislation around biofuels has hindered these technologies from taking off. Companies are continuing to experiment as they realise the opportunity of reducing fuel costs through newer technology.

Centobelli et al. (2017) discussed that green innovation in supply chain could be classified in many ways, including sustainability goals, carbon footprint reduction, alternative fuels, and GHG emissions reduction. These initiatives can further be classified into those carried out by the organisation internally and those carried out externally in collaboration with partners. The ability to extend green innovation across the value chain is an essential component towards achieving environmental sustainability. Previous studies carried out globally have identified the performance improvement both from an economic and environmental point of view following the implementation of green innovation in supply chain.

Based on the above, in a developing economy context, South African companies need to partner with organisations in developed countries with success in technologies around waste reduction and cleaner fuels. The assessment of the technologies needed should extend across the value chain to identify areas where carbon emissions can be reduced. South Africa seems to be a laggard in implementing technologies, choosing instead to wait before establishing whether the

economic benefits are guaranteed and then only implementing the supply chain technology. The renewable drive is expected to continue in the medium to long term, with the cost of the technology proving financially beneficial along with the supply risk of electricity in the country.

As further highlighted by Veres and Mousa (2020), technology improvement has played a significant role in driving green innovation in supply chain. Data-driven techniques allow for the implementation of machine learning across the value chain in transportation to improve fleet management or traffic flow prediction. Respondents supported the view of implementing technology software to optimise current supply chain movements. Implementing newer software was less of an investment when compared to structural and capital infrastructure. It was an easier win in terms of gaining economic benefits through data-driven supply chain efficiencies. It also opened up new avenues to share data with partners in the value chain, thus allowing better planning. This has the resultant impact of reducing cost and carbon emissions through share and reuse and reverse logistics. Standing et al. (2018) mentioned that freight sharing allows for the transportation of goods in a shared environment, reducing cost to the consumer. Freight sharing in the South African context proved a bit more difficult for respondents as there are concerns about losing market share due to the market's competitive nature.

Overall, respondents agreed with the view of Cousins et al. (2019) that green supply chains have been proven to improve environmental and operating costs. They also supported the technologies in green and circular supply chains to incorporate repair, reuse, refurbish, and recycling. This is highlighted in figure 8, which represents a circular supply chain business model.

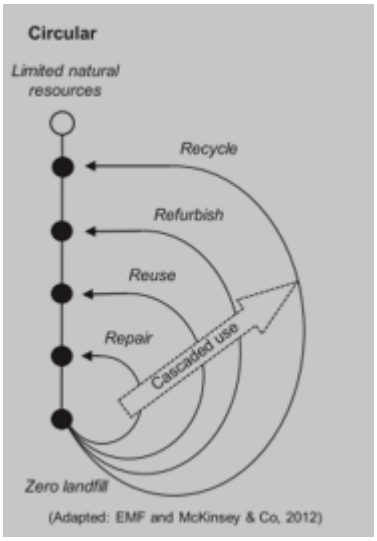


Figure 8: Comparing traditional, sustainable and circular supply chains

(De Angelis, Howard, & Miemczyk, 2018)

Conclusion on the discussion of SQ2

Participants supported the implementation of green technologies according to circular economy principles. Technology software was preferred as a lower-cost option to optimise supply chain performance and improve carbon emissions. In terms of infrastructure, most of the implemented technologies had to have proven economic benefits, coupled with reducing operational risk to support green innovation. As technologies improve and the cost-benefit associated with those technologies improve, companies will investigate implementing them in the supply chain. A collaborative approach with partners in the value chain offers potential for innovative ways to reduce or share costs and implement greener technologies towards circular economy principles in the supply chain.

6.1.3. Discussion on SQ3

<u>What changes (internal drivers) that can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy</u>

Introduction to discussion on SQ3

Some of the key themes emerging from the participants' internal drivers included sustainability as a key pillar of the strategy, developing an internal sustainability network, culture and values, value proposition, and awareness and training. These all will be discussed below in light of literature to formulate the inner mechanisms

that support green innovation and circular economy amongst South African supply chain companies.

Sustainability strategy

Millar et al. (2019) supported the view that top-down or a bottom-up approach could be followed in implementing circular economy. However, the respondents favoured a top-down approach in South Africa as this sets the scene for the strategy to be rolled out more quickly. Having top management support the drive towards green innovation and the resources that go with it presents a much more straightforward approach. Govindan and Hasanagic (2018) mentioned that top management support is needed towards implementing circular economy in supply chain. This is aligned with the participants' views as well.

Participants envisaged the sustainability strategy as one of a longer-term vision towards the company's continuity, thriving in its environment and uplifting the social aspects of the communities it operates in. They indicated that sustainability could be seen as a separate pillar of the strategy that is adequately resourced to formulate and execute strategy. As most of the participants are JSE listed, it is evident through their sustainability reports that top-management support makes the reporting go beyond a "tick-box" function. It instead embraces the drive towards reducing carbon, implementing more efficiencies around green innovation across the supply chain. Each company had varying methods of implementing strategy and choosing which initiatives to target first. The idea of low hanging fruits supports the easiest approach to strategy implementations whereby those proven technologies are supported at a board level. Tran et al. (2019) also mentioned support of top-level management of innovation as key to drive innovation which is aligned to the participants' approach.

Sustainability network

While respondents favoured a top-down approach, they also acknowledged that momentum was important for the sustainability strategy and that the responsibility could rest with the sustainability department. Having the right human capital was a driver mentioned by Soewarno et al. (2019) coupled with commitment towards green. The sustainability network explained by participants included management across the business that influenced the organisations' commitment towards green and sustainability.

Some participants extended the sustainability network to include experts beyond the organisation. The inclusion of external experts may assist companies in gaining newer knowledge of technologies and processes that could work towards growing initiatives to green. Batista et al. (2019) expressed the importance of building capability internally to develop networks beyond the supply chain organisation. Sustainability networks present an excellent opportunity to collaborate with partners in the network, as discussed further in the business model changes section.

Culture and Values

Ethics play a significant role in driving a company towards green. Values mentioned by participants included doing things for the right reasons and not just for compliance or marketing purposes. There was a need to correct the wrongs humanity has done to the environment in the past, and organisations want to support this cause in any way it can. The literature speaks about environmental ethics and the role that organisations, society, government and consumers need to pay towards achieving sustainability. Govindan and Hasanagic (2018) provided this framework in a multi-stakeholder view of the drivers towards circular economy in the supply chain.

As mentioned by participants, culture plays a significant role when creating a drive towards green. Developing a sustainability culture is one way of promoting green within the organisation. Openly communicating sustainability as a strategy also promotes green and moving towards a circular supply chain model.

To build an experimental culture, companies need to adopt an experimental approach to green innovation, whereby the employees within the organisation get to experience successful experiments. Particularly when it comes to technology, there may be instances where a proven technology does not work in a South African context due to technology adaptation. This was highlighted as one of the barriers to implementation in South Africa, however through an experimental culture, these barriers may be overcome.

Value proposition

Laari et al. (2017) established that companies used green to develop a stronger value proposition through improved brand image and market differentiation, allowing them to charge a premium. Value proposition from an internal driver perspective is quite closely aligned to the external driver of competitive advantage. Sustainability was used as a key-value proposition, not only for customers but also for employees.

Companies are beginning to understand that the employee value proposition helps gather the best talent and encourage engagement. Just as customers do not want to be associated with companies that contribute to harming the environment, so do employees. Using sustainability as a value proposition through new green innovation encourages employees to believe in the value proposition the organisation is building to contribute to society in a positive light.

Awareness and training

Education on circular economy principles of recycling, remanufacture and reuse was one of the supporting practices encouraged by Govindan and Hasanagic (2018). They also added that training is required on circular economy in the supply chain. Participants supported this view as they felt that training and awareness were key to implementing a strategy around green.

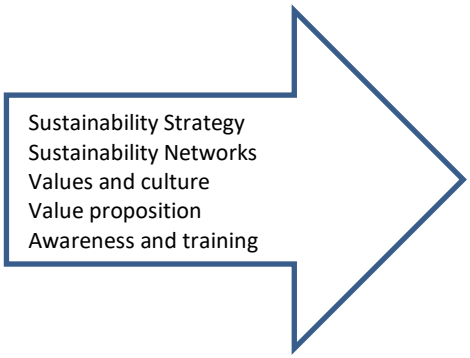


Figure 9: Results of SQ3

Conclusion on the discussion of SQ3

The literature supports most of the internal drivers that participants considered as influential towards implementing green innovation and circular economy in the supply chain. The research additions are around sustainability networks that are made up of internal and external personnel supporting and driving initiatives to the strategic pillar of sustainability. These networks support change and drive internal innovation, process and behaviour that encourages green. Participants view sustainability as more closely aligned with green processes and innovations. There is a more profound appreciation that sustainability includes the triple bottom line of economic, social and environment.

6.1.4. Discussion on SQ4

What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based

Introduction to discussion on SQ4

The respondents provided insight into what business model changes could be made that would support circular economy and green innovation in the supply chain. These included collaboration across the supply chain, integration across the supply chain, and changing measurement systems to support social and environmental measures. Currently, most companies tend to focus only on economic measures when they carry out internal or external performance management.

Social and environmental measures

Abbasi and Nilsson (2016) mentioned that there is difficulty obtaining measurements to benchmark green initiatives to diagnose and assess environmental impact. Participants acknowledged that this is an imperative in changing the business model and measuring and reporting on the environment. New systems and processes were being investigated and implemented by participants to include carbon emissions and societal impact as imperatives.

Business model changes allow circular economy to be implemented

Govindan and Hasanagic (2019) mentioned that supply chain management is a key link in this system as it covers the entire value chain. Respondents agreed with this and highlighted that more thought needs to be given by business on how this can be achieved to improve innovation. Collaboration was provided as a solution by respondents to work together with sustainability and supply chain partners from other organisations. Petljak et al. (2018) also highlighted the importance of collaboration in the supply chain as a central point of green supply chains. If these partners in the supply chain could be included in the organisations' network, then this will support internal drivers of green innovation and circular economy. Incorporating shared training and awareness sessions with partners in the supply chain allows for building a shared purpose towards sustainability.

Centobelli et al. (2017) stated that it was important that green innovation be extended across the value chain as this promotes environmental sustainability and green. This

was also supported by the respondents' views on extending the supply chain across other value chain partners, even if they may be from other industries. Batista et al. (2019) added that leadership needs to play the role to create the capability to extend collaboration across the supply chain and create the necessary training and technical advice to achieve collaboration.

Collaboration across the value chain allows for newer innovation in business models that includes circular economy principles such as share, reuse, and shortening the closed-loop cycles through better efficiencies. The improved collaboration allows for better planning, particularly in product design or waste reduction through the end of life considerations. One of the barriers highlighted by a few participants was around the linear infrastructure that may only be overcome through supply chain collaboration and redesign.

Geissdoerfer et al. (2018) state that they had attempted to link sustainable supply chains to the circular business model to provide a strategic management view and systemic view of circular organisation made up of circular business models and circular supply chains. As mentioned previously, it would be good to link the enablers and drivers to this model to create a holistic picture of the drivers that support circular supply chains within the strategic management view. Participants supported the need for business models to be easily understood for other companies to bring in circular supply chains into the strategic management framework by incorporating the drivers and innovations that best support sustainability.

De Angelis et al. (2018) presented circular supply chains as a collaborative value capture model using the concepts of repair, reuse, refurbish and recycle. Participants explained their innovations according to these concepts and believed that more benefits could be achieved in reducing emissions by closing and narrowing loops within the circular supply chain model. As most of the companies were large organisations in the supply chain, they naturally took on the role of lead actor in co-ordinating the green supply chain initiatives. Bressanelli, Perona and Saccani (2019) supported the view of a main actor in the supply chain playing the pivotal role of co-ordinating and applying pressure on other organisations in the chain to design the supply chain according to circular economy principles

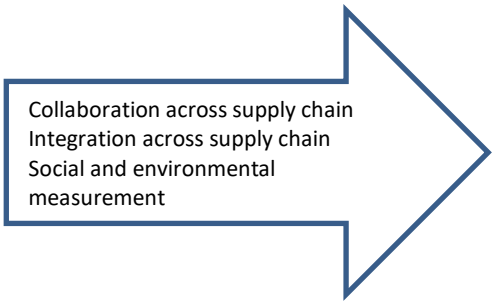


Figure 10: Results of SQ4

Conclusion on the discussion of SQ4

The recommendations provided by the participants are aligned with some of the thoughts in literature around what needs to be done from a business model perspective to cater for the drive to sustainability along with green innovation and circular economy.

6.2. Discussion on the main research question

What are the key drivers that support green innovation and circular economy in supply chain?

In answering the research question on the drivers of green innovation and circular economy in the supply chain, the figure below represents a summary of those themes that align with the literature and add in new literature to cater for the South African perspective.

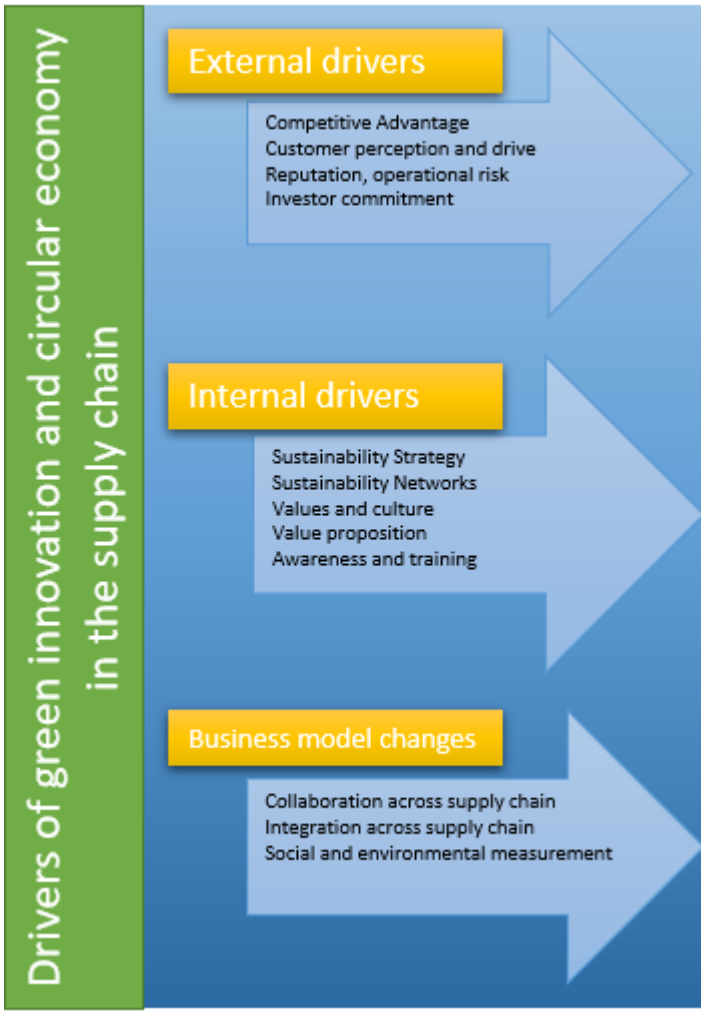


Figure 11: Summary of results

6.3. Business model

Circular supply chains were discussed by Geissdoerfer et al. (2018), who mentioned that a circular business model is brought into the supply chain management with the intent of waste reduction, emission leakage and better material usage to improve efficiency and generate competitive advantage.

The circular supply chain model is aligned with the participants' views as they developed new ways to repair, reuse, refurbish(renew) and recycle. The model could align with the 6R concept mentioned in Govindan and Hasanagic (2018), which included the redesign and remanufacture as participants also expressed these views. The model presented below links green innovation and circular economy drivers to the supply chain to the circular supply chain model. In this model, organisations may get a holistic view of implementing the circular economy and green innovation in the supply chain from a South African perspective. Participants highlighted that the need for change was a challenge in a South African context and

this model seeks to address this by including the necessary steps from a strategic management perspective that will allow easier adoption of green and circular economy in the supply chain.

The figure below incorporates the drivers of green innovation in the circular supply chain to the left. It also brings in the principles from the 6R model to the right and the organisational perspective from the framework proposed by Geissdoerfer et al. (2018). Geissdoerfer et al. (2018) mentioned that circular supply chains enable circular business models to intensify and narrow the supply chain loops to reduce waste and improve economic benefit. The intention is to add the enabling drivers from a South African perspective to this model to better understand the levers that companies can pull to make the change towards green in the supply chain.

The 6R (reduce, reuse, recycle, recover, redesign and remanufacture) concept included in one circle within the model is aligned to the participants' views and the circular supply chain model developed by De Angelis et al. (2018). This is included in the model as it illustrates how participants adopted experimental culture to green innovation by engaging with circular economy practices around what innovations worked best for South African companies. These innovations included renewable energy, water harvesting and waste reduction through recycling and reuse as they presented the most feasible opportunities to drive operational stability, improve economic profit and reduce carbon emissions.

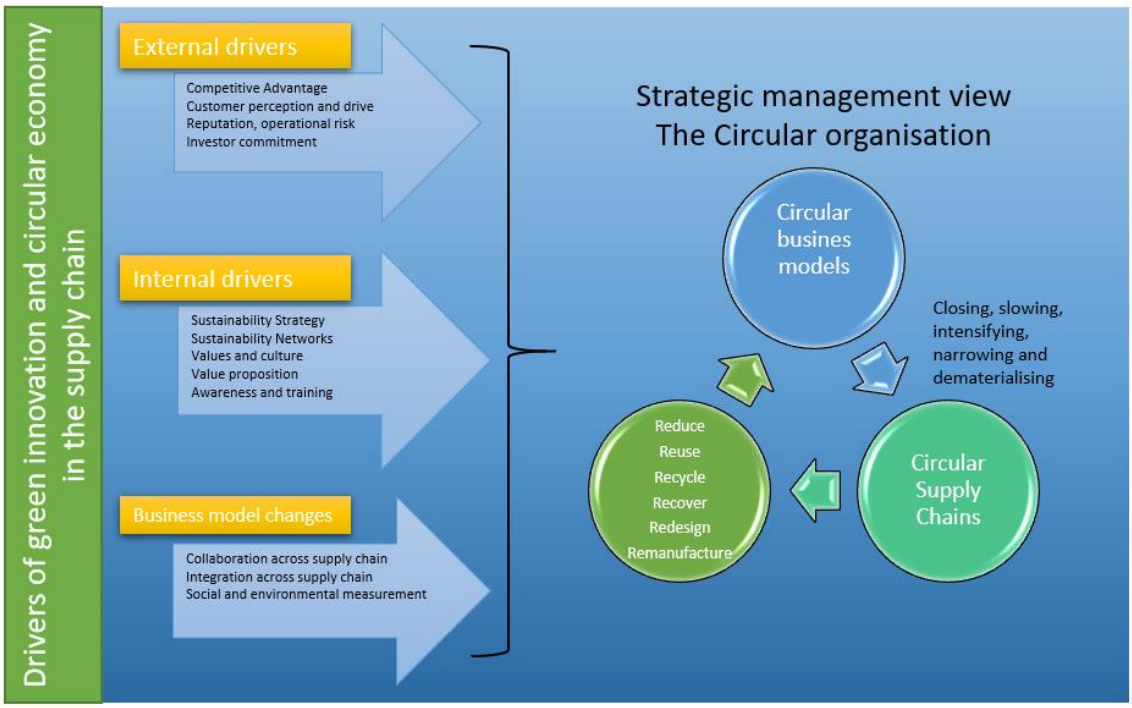


Figure 12: Drivers towards circular business models

(Authors own construct)

Based on the above model, the recommendations from this research are presented in a summarised model that supports the drive, and business model changes need to adopt circular business models and innovation in the supply chain. The answers to research questions are framed in a holistic view supporting both the drivers to green innovation and circular economy in the supply chain to create circular business models and circular supply chains. Companies can leverage green innovation to support circular economy by extending their collaboration across the supply chain to adopt those technologies that have the best economic benefit along with environmental benefits. Adopting this model in South African supply chain organisations will allow for better realisation of green and circular economy. The ultimate intention of this is to improve economic growth to sustain companies, create job growth and build sustainable supply chains without harming the environment.

7. CHAPTER 7: CONCLUSION

The conclusion will discuss the outcomes presented following the findings and analysis conducted in Chapter 5 and Chapter 6. The implications for the various stakeholders identified in chapter 1 are listed below and limitations of the research, and potential areas to be explored as part of future research.

7.1. Research questions and objectives

The supply chain generates significant carbon emissions, waste and inefficiency that contributes to environmental degradation, which compounds South Africa's economic issues of low growth when compared globally. The circular economy was presented as a framework that has proven successful in developed countries in improving waste reduction and green and driving green technology and economic growth.

The circular economy is defined as an economic system that can restore and regenerate through supply chain organisations either independently or through collaboration, redesigning the business model to replace previous end-of-life concepts. The circular economy is directly linked to green innovation and green supply chains. The core research question was drivers of green innovation and circular economy in the supply chain amongst South African companies.

Following many international studies of circular economy in the supply chain amongst developed countries, as highlighted in the Literature matrix in Chapter 2, it was necessary to understand how drivers of green innovation and circular economy in developing countries differ. The answers from the research question are intended to provide a framework for organisations in the South African supply chain to understand how circular economy can result in positive economic and environmental benefits. The answers also expand on innovations have been adapted successfully to date by South African supply chain organisations. The framework splits out the drivers between external and internal to understand what levers of change may be used by a company in achieving green.

7.2. Drivers of green innovation and circular economy in the supply chain

The drivers of green innovation and the circular economy in the South African supply chain present many commonalities between a developing country being South Africa

compared to developed countries. The study continues the work of Govindan and Hasanagic (2018) on drivers and barriers of circular economy in the supply chain and that on circular business models identified by Geissdoerfer et al. (2018). The additions from this research explained how companies responded to operational and supply chain risk in a proactive manner, mainly due to external circumstances. South African specific conditions around electricity supply and water security created long term risk for companies which pushed them towards newer green innovations in the supply chain.

The investor commitment and support are also important as an external driver to investing in green innovation amongst South African companies. Companies seek to align with global green standards to ensure that investor funding can continue to be received.

Through its low growth rate and highly competitive business environment, South Africa needs to extract economic benefit from any green innovation and sustainability initiatives to gain a better competitive advantage. Companies have a preference to engage with proven green technologies that could reduce costs and improve the company's ability to sustain itself in the longer term.

The green innovations that best supported circular economy in the supply chain aligned with the literature to drive both the economy and green. Renewable energy and water harvesting proved common across most participants. They also looked at new ways of reducing waste and improving carbon emissions from fuel usage as these presented positive economic benefits to support competitive advantage.

From an internal driver perspective, the literature aligns with that proposed by international journals. In South Africa, there is a greater need for sustainability networks to create a platform for change. Companies may feel alone on this green journey due to the South African government's slow drive for environmental and green initiatives. While policy and regulations exist, organisations feel they need to create the drive and change towards green on their own.

In terms of business model changes, collaboration across the supply chain with partners across industries presented the best opportunity to support the circular economy. Sharing knowledge and redesigning supply chains may be improved

because supply chain partners can agree on mutually beneficial initiatives towards green supply chains and improved economic performance.

Participants indicated that environmental and social measures need to be incorporated into supply chain measurement. This change in the way companies are measured will support the drivers of green innovation and circular economy in the supply chain.

7.3. Contribution to the literature

A model is presented in Chapter 6 which summarises the recommendations how external and internal drivers along with business model changes can be linked from a strategy perspective to circular supply chains and circular business models.

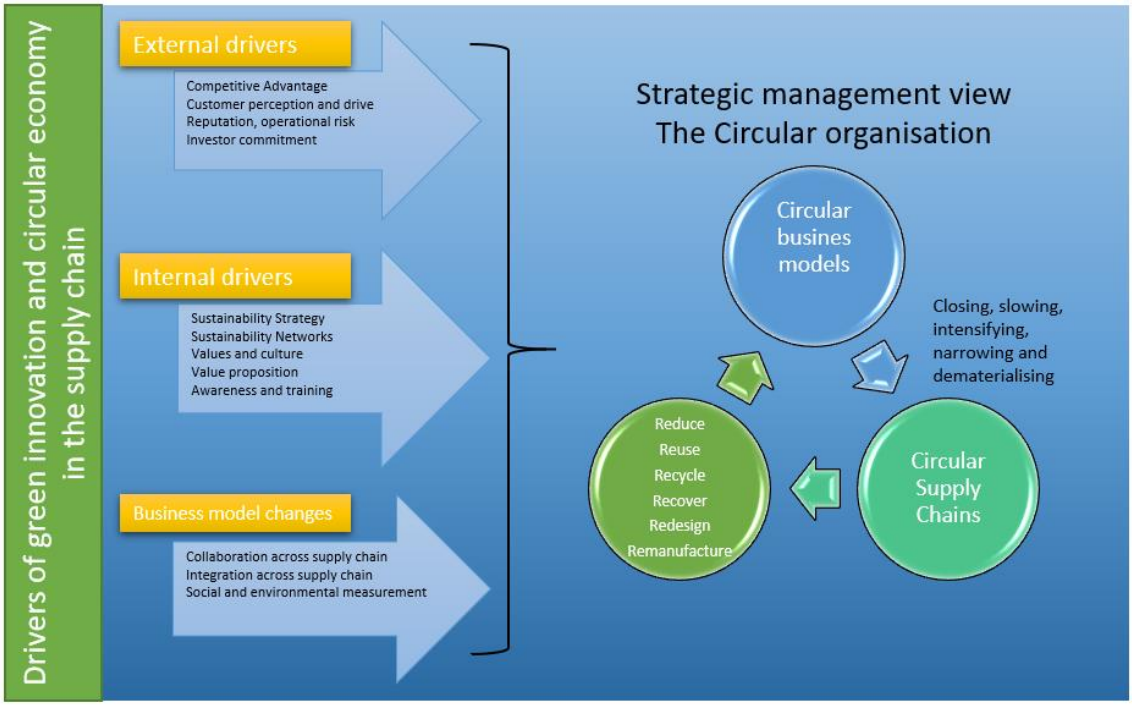


Figure 13: Integrating the drivers to circular business models and circular supply chains

(Authors own construct)

Supply chain organisations in South Africa can proactively consider how to respond and plan around drivers that may impact them externally. Particularly in a South African context, competition and customer drive are essential to revenue generation and market share protection. Introducing technologies around waste reduction and implementing circular business models in the supply chain will allow organisations to advance green and sustainable strategies. Much consideration needs to be made around internal drivers and business model changes such as building the correct

culture and collaborating across the supply chain to implement green and sustainable strategies. Innovation and experimental culture are necessary to adopt new technologies or new processes to move a company towards driving circular principles and implementing circular business models.

The research contributed to the literature from a developing economy perspective whereby the drivers of green innovation and circular economy in the supply chain have been extended from the global perspective. It also added more in-depth perspectives of research participants, which goes beyond the number of conceptual studies in the research.

The research extended the practical application of green innovation in the supply chain, resulting in positive economic and environmental benefits. These examples make it easier for other companies to form a link between green innovation, circular economy and supply chain.

7.4. Implications for management

7.4.1. Supply chain and sustainability executives

Sustainability and supply chain managers are agents of change within the business to drive green and circular economy. They have the seniority to build networks inside and beyond the organisation to collaborate towards capturing more initiatives across the supply chain that promotes green.

They are also close to the customer requirements to ensure that the initiatives that customers' drive in greening the supply chain can be executed upon. This makes for more sustainable supply chains, which result in positive economic and environmental benefits across.

7.4.2. Leadership team

The propensity for organisations to change in adopting green innovation in supply chain is made a lot easier once the leadership team has set the correct tone from the top. The direction and allocation of resources towards green innovation will promote the sustainability of the company. Leaders need to build a sustainability culture by

identifying sustainability as a major pillar of the strategic drive. Some companies conveyed that doing the right thing resonated with the organisation's personnel and motivated them to create the change. This leans onto leaders' ethical decision-making to make the right choices in doing business that promotes sustainability.

7.5. Limitations of the research

The study is focused on the South African supply chain, and the outcomes may be specific to the South African context. It is not certain that other developing countries may have the same drivers towards green innovation in the supply chain. The reason for this is that the landscape in South Africa may be context specific. An example of this is the electricity outages, and water security problems may drive operational risk drivers to implement newer technologies that are environmentally related.

During this research the organisational perspective was focused on, which did not include other stakeholders such as government and society and their implications. Incorporating stakeholder theories into the circular economy in supply chain may present added insight.

7.6. Suggestions for future research

A quantitative study may be conducted using the research themes and categories for the drivers of green innovation in supply chain. This will assist in establishing correlations between internal drivers and external drivers. The research may be narrowed to only focus on manufacturing within the supply chain to extract value for the manufacturing industry around circular economy implementation. The study may also be extended to a different unit of analysis, such as managers of smaller organisations, to compare how environmental and economic challenges impact smaller businesses.

Leadership plays a significant role in the business model changes needed to implement circular economy in the supply chain as mentioned by Batista et al. (2019). It may be valuable to understand the perspective of South African companies that have different board demographics in terms of their propensity to change business models towards green.

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Appendix 1: Questionnaire

Name of individual:

Company:

Title:

Date:

Start time:

End time:

Introduction

- This study focuses on the key drivers that support green innovation and circular economy in supply chain
    - Objective 1: Determine which areas in the supply chain where green innovation can result in positive economic and environmental benefits
    - Objective 2: Understand what changes can be made by organisations in South Africa to adopt more green innovation and circular economy practices in their strategy
    - Objective 3: What practical approaches can be taken by companies in South Africa to adjust their business model to become more circular economy based
- The recommendations from these questions will assist companies in providing a roadmap towards sustainable supply chains
- The interview is exploratory in nature and is meant to encourage openness of communication
- All information will be maintained with confidence
- A consent form will need to be signed prior to commencing
- Please advise if you are comfortable that the interview may be recorded for academic purposes
- The template questionnaire provides 10 open-ended questions to allow for more questions to follow based on the conversation

Number	Question
1	Please provide an overview of your role in the company and what involvement you may have in environmental sustainability
2	Please explain your companies Green supply chain and green innovation strategy

3	How has your company actually performed against the strategy? Please elaborate on actual versus targets.
4	What are the biggest drivers and barriers to implementing the green innovation in supply chain and logistics? Please explain each one in detail
5	Please elaborate on which areas of the green innovation may bring about the most significant impact to cost reduction or increased profitability
6	How do you create the change required in the organisation to achieve the green innovation strategy
7	What is your understanding of the circular economy model in relation to your current business model
8	What scope within the value chain is there to reduce cost or waste according to CE principles
9	What changes to the current business model can be adopted to bring in green innovation
10	Reflecting on companies that have been successful in their green supply chain journey, what more could South African companies do to bring about change

Appendix 2: Coding

Themes for External drivers (SQ1)	Subcategories	Frequency of codes
Competitive Advantage (5.6.1.1.)	Competitive Advantage	4
	Technology leader	2
	Efficiency	2
	Brand	1
Customer perception and drive (5.6.1.2.)	Customer perception of green supply	3
	Customer driven green journey	6
Reputational and Operational risk (5.6.1.3.)	Operational risk	4
	Reputational risk	2
	Environmental shocks	1
Legislation (5.6.1.4.)	Government incentives	2
	Government taxes	2
	Compliance	2
Investor (5.6.1.5.)	Investor commitment	3
Environment (5.6.1.6)	Reduce carbon footprint	2
	Share and reuse	1
Themes for green innovation (SQ2)	**Subcategories**	**Frequency of codes**
Green innovation in supply chain	Renewables	7
	Water reticulation	6
	Waste reduction	7
	Biofuels	5
	Reusable materials	4
	Other	9
Themes for Internal drivers (SQ3)	**Subcategories**	**Frequency of codes**
Sustainability strategy	Separate sustainability function	6
	Leadership and strategy	7
	Green roadmap	2

Sustainability network	Start at senior management level	4
	Business champions	2
	Association	3
Culture and Values	Experimental culture	4
	Sustainability culture	4
	Doing it for the right reasons	5
Value proposition	Efficiencies	2
	Financial benefit	3
Awareness and training	Awareness	3
	Training	1
Themes for business model changes (SQ4)	Subcategories	Frequency of codes
Business model changes	Collaborate across the supply chain	8
	Change business measurements	5
	Other	11
Total		**145**