MODELLING THE RELATIONSHIP BETWEEN GREEN SUPPLY CHAIN MANAGEMENT PRACTICES, DYNAMIC CAPABILITIES AND SUPPLY CHAIN PERFORMANCE IN THE SOUTH AFRICAN MANUFACTURING SECTOR

by

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DEDICATION

I dedicate this PhD to my family in South Africa and in my homeland Cameroon.

ABSTRACT

The quest for sustainability as a result of both resource scarcity and customer environmental conscious attitude has prompted manufacturing companies to start investing in green innovation and technology. The adoption and implementation of green supply chain management (GSCM) is still in its early stage in South Africa. The aim of the study is to contribute to the body of knowledge by providing a research model for the relationships between green supply chain management (GSCM) practices, supply chain dynamic capabilities (SCDCs) and supply chain performance (SCP) in the South African manufacturing sector.

Quantitative data were collected from 402 respondents of the South African manufacturing sector in Gauteng, Free State, Mpumalanga and Limpopo through online survey questionnaires using a cross-sectional design. The collected data were tested using a partial least squares structural equation modelling (PLS-SEM) through Smart-PLS 3 and the Statistical Package for Social Sciences (SPSS) for data screening (descriptive statistics).

The results of the study suggest that GSCM practices, which include eco-design (ED), green distribution (GD) and green training (GT), exert a positive and significant impact on SCDCs, which in turn positively influence SCP through supply chain agility (SCA), supply chain reliability (SCRELL), supply chain costs (SCCs), supply chain responsiveness (SCR), customer satisfaction (CS) and supply chain balance (SCB) in the South African manufacturing sector.

This study contributes to the body of knowledge, innovation, and organisational capability literature of the manufacturing sector by providing a comprehensive model for the relationships between GSCM practices, SCDCs and SCP.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS/ACRONYMS

ABC:	Activity-Based-Cost
ADP:	Automotive and Development Programmes
ANOVA	Analysis of Variance
ASGISA:	Accelerated and Shared Growth Initiative for South Africa
AVE:	Average Value Extracted
BBBEE:	Broad-Based Black Economic Empowerment
BRICS:	Brazil, Russia, India, China, South Africa
CFA:	Confirmatory Factor Analysis
CMB:	Common Method Bias
CMT:	Cut-Make and Trim
CS:	Customer Satisfaction
CT:	Contingency Theory
CVM:	Common Method Variance.
DC:	Dynamic Capabilities
DCT:	Dynamic Capability Theory
DRC:	Dynamic Remanufacturing Capability
DTI:	Department of Trade & Industry
ED:	Eco-design
EDP:	Enterprise Development Programme
EFA:	Exploratory Factor Analysis
FDI:	Foreign Direct Investment
FMBWA:	Factories, Machinery and Building Work Act
GAA:	Group Areas Act
GATT:	General Agreement on Tariffs and Trade
GD:	Green Distribution
GDP:	Gross Domestic Product
GEAR:	Growth Employment and Redistribution
GM:	Green Manufacturing
GP:	Green Purchasing

GSCM:	Green Supply Chain Management
GSCMPs:	Green Supply Chain Management Practices
GT:	Green Training
ICA:	Industrial Conciliation Act
ICT:	Information and Communication Technology
IMF:	International Monetary Fund
IPP:	Industrial Policy Projects
IT:	Institutional Theory
ITAC:	The International Trade Administration Commission of South Africa
JIT:	Just-in-time
KMO:	Kaiser Meyer Olkin
KPIs:	Key Performance Indicators
LCA:	Life cycle assessment
LR:	Legislation and Regulations
MIDP:	Motor Industry Development Program
MNEs:	Multinational Enterprises
MRPII:	Manufacturing Resource Planning
NDP:	National Development Programme
NFI:	Normed Fit Index
NGO:	Non-Governmental Organisations
PAGE:	Partnership for Action on Green Economy
PCA:	Principal Component Analysis
PLS-SEM:	Partial Least Squares Structural Equation Modelling
PR:	Product Returns
R&D:	Research and Development
RBT:	Resource-Based Theory
RL:	Reverse Logistics
SA:	South Africa
SAAM:	South African Automotive Masterplan
SAG:	South African Government

SCA:	Supply Chain Agility
SCB:	Supply Chain Balance
SCC:	Supply Chain Cost
SCDCs:	Supply Chain Dynamic Capabilities
SCM:	Supply Chain Management
SCN:	Supply Chain Network
SCOR	Supply Chain Operations Reference
SCP:	Supply Chain Performance
SCQ:	Supply Chain Quality
SCR:	Supply Chain Responsiveness
SCREL:	Supply Chain Reliability
SEM:	Structural Equation Modelling
SIP:	Strategic Investment Program
Smart-PLS:	Smart Partial Least Squares
SME:	Small to Medium Enterprise
SMMR:	Single Manufacturer and Multiple Retailers
SPSS:	Statistical Package for Social Sciences
SRMSR:	Standardised Root Mean Square Residual
Stats SA:	Statistics South Africa
TIPS	Trade and Industrial Policy Strategy
UNEP:	United Nation Environmental Programme
UNIDO:	United Nation of Industrial Development Organisation
UNISA:	University of South Africa
US:	United States
USA:	United States of America
WTO:	World Trade Organisation

CHAPTER 1

ORIENTATION OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

The manufacturing sector is one of the pillars of the economic growth of any given country and it is at the same time vital for job creation (Bag *et al.*, 2018). The sector plays a critical role in the development of the global economy and its interlink with other players of the economy such as mining, trading, supply chain, financial services allow the manufacturing to contribute significantly to the economy (Thurner & Roud, 2016, as cited by Seth *et al.*, 2018). According to Statistics South Africa (2018), the manufacturing sector is the fourth largest in South Africa and contributes 14 per cent to the country's Gross Domestic Product (GDP). Furthermore, the South African manufacturing production rose by 1.2 per cent in 2018, compared to 2017, thereby assisting the country to ease the pressure of an economic recession (Statistics South Africa, 2018). The manufacturing sector has the potential to create job opportunities, eradicate poverty and improve the living standards of the working class (Seth *et al.* 2018). As Mashiloane *et al.* (2018) reported, the manufacturing sector in South Africa employed almost two million workers in 2017, making it one of the most important players in the economic growth of the country. These contributions illustrate the essential role that the manufacturing sector plays in fostering the socio-economic growth of South Africa.

Despite the critical role played by the manufacturing sector in the growth of the South African economy, it is still inundated with multiple challenges that inhibit its further development. These challenges include but are not limited to, global competition, climate change (Partnership for Action on Green Economy [PAGE], 2018; Kan, Mativenga & Marnewick, 2020), social welfare of the population and political stability (Statistics South Africa, 2018; Ali, Tursoy, Samour, Moyo & Konneh, 2022). To effectively tackle these challenges, the manufacturing sector must embrace the shift toward supply chain practices that aim to promote sustainability (Maama, Doorasamy & Rajaram, 2021). Sustainability requires that manufacturing firms take measures, not only to focus on creating wealth for their shareholders through profit maximisation but also to resolve environmental and social concerns. Moreover, within the field of supply chain management (SCM), sustainability imperatives are captured through the practice of green supply chain management (GSCM), which when integrated into the supply chain network can provide considerable benefits to all members of the supply chain (Garbie, 2017). SCM can be defined as a process of coordinating supply chain operations from the purchase of raw materials to the distribution of final products to customers (Talatappeh & Lakzi, 2019). According to Garbie (2017), cooperation and collaboration between supply chain members bring benefits that include an increase in competitiveness, profitability, productivity and market share. These benefits enable individual manufacturing firms to improve their supply chain performance (SCP). Because of the significance of the manufacturing sector, further research must be conducted to allow practitioners and academics to understand better the benefits associated with the adoption and implementation of green practices.

In principle, GSCM practices extend the traditional concept of SCM by providing an improvement of products and services that are eco-friendly across their complete life cycle (Ahi & Searcy, 2015; Gunasekaran *et al.*, 2015; Epoh & Mafini, 2018). Supply chains must be managed in a way that improves effectiveness and efficiency and minimises the impact of business activities on the environment. Several scholars (Srivastava, 2007, as cited by Famiyeh *et al.*, Dadzie, 2018: 608) describe GSCM as integrating environmental thinking into the supply chain, which includes the design of the product, procurement and selection of materials, manufacturing processes, delivery of the final products to the consumers as well as end-of-life management of the product after its useful life. GSCM aims at reducing the impact of business activities on the environment and at the same time improving the performance of the supply chain. According to Zaini *et al.* (2014), GSCM can also be considered as a strategy that enables organisations to compete in the global arena. As competition increases in the marketplace, it becomes inevitable for organisations to have a dynamic capability (DC) that will enable them to regenerate their strategies to manage change and sustain their businesses. Ju *et al.* (2016) ascertain that core competencies within organisations help to differentiate these firms from their rivals and are a source of competitive advantage. The authors further assert that core competencies provide firms with the capability to create value for their customers.

Given the intense pressure of globalisation, technological development and competitiveness, it becomes paramount for firms to develop DCs. Including the concepts of DC into the field of GSCM will enable firms to achieve sustainable competitive advantage and improve SCP (Hong *et al.*, 2018). These capabilities will also allow firms to adapt and adequately address supply chain dynamics. DC can be defined as the firm's ability to integrate, build and reconfigure its internal expertise to address change in an unpredictable business environment (Teece, 2017). Ju *et al*. (2016) also define DC as the ability of a firm to integrate and organise its internal and external resources, which provides an opportunity to create value through mechanisms that are not replicable. Furthermore, DC empowers firms with the ability to adjust and adapt to the ever-changing market environment, making it an enabler of market dominance through continued implementation of versatile strategies based on environmental changes. Hitt *et al.*, (2016) indicate that DCs mostly emphasise resource development and renewal, making it essential for a firm to seek constant reinvention, build a fast-paced culture and create a driven-based network with other important players in their industry. Additionally, DC is vital in the development of new technologies as well as in the quest of sustainable competitive advantage through efficiency and effectiveness of the supply chain.

Literature suggests that combining GSCM practices and DCs can improve the performance of the supply chain up and downstream. A study by Hong *et al.* (2018) revealed that GSCM practices have a significant positive effect on supply chain dynamic capabilities (SCDCs) and all three dimensions of a firm's performance which include social, environmental and economic performances. Research results by Liao, Hu and Ding (2017) indicate that supply chain collaboration and value innovation could facilitate the enhancement of the firm's competitiveness through an improved SCP. Cheng, Chen and Huang (2014) advocate that in a highly contested market, firms must develop unique DCs that can significantly contribute to improving the SCP through innovative initiatives and product development. SCP describes the process of evaluating the effectiveness and efficiency of supply chain activities within the supply chain network using performance metrics (Lima-Junior & Carpinetti, 2019).

Although similar studies have been done before in the field of SCM, some substantial differences and gaps still exist in literature in terms of dimensions used to measure the effective implementation of GSCM. All these various dimensions play the common role of achieving both operational and environment transformations through green technology. Furthermore, green practices are known for their ability to spread green ideology, reduce the impact of supply chain activities on the environment and for their potential to assist practitioners to refine their skills and competencies in countries such as Palestine and Brazil (Zaid, Jaaron & Bon, 2018; Sellitto, Hermann, Blezs Jr & Barbosa-Póvoa, 2019). Green practices in the current study are measured in terms of green purchasing, eco-design, green manufacturing, green distribution, reverse logistics, legislation and regulations and green training. The performance of the supply chain is measured through supply chain agility, supply chain reliability, supply chain costs, supply chain responsiveness, supply chain quality and supply chain balance. These performance measures can help South African manufacturers and their suppliers to allocate resources adequately within their supply chains and set long-term objectives.

The attempt with the present study is to contribute to the existing body of knowledge by examining how GSCM practices are connected to DCs and specific components of SCP.

1.2 THESIS STATEMENT

The South African manufacturing sector is plagued with sustainability-related problems, despite its evident desire to transition to green manufacturing. The low pace towards the implementation of sustainable measures has resulted in inefficiency and ineffectiveness at various levels, as well as slowed down the competitiveness of the manufacturing sector. To enhance the competitiveness of this vital player of the South African economy, both locally and internationally, manufacturers need to develop operational efficiency (ability to use resources more efficiently in a way that reduces operational cost) throughout their supply chain networks by improving their competencies (ability to integrate, develop, innovate and reconfigure existing resources to respond to specific uncertainties in a high-velocity market) and embracing practices that promote sustainability for a sustainable competitive advantage.

1.3 PROBLEM STATEMENT

Despite the ratification of the Paris agreement in 2015 by the world economies to reduce their carbon emissions, as well as the efforts of the South African Government to reinforce the implementation of the accord in its various economic sectors, the issue of air pollution, water pollution, soil pollution, wildlife destruction, climate change and global warming still remains the “grand” challenge for South Africa, now and for decades to come (Partnership for Action on Green Economy [PAGE], 2018). Moreover, it is important to stress that the manufacturing sector contributed almost 20 per cent to the total emissions in South Africa between 1999 and 2015, making it one of the most important polluters in the country (Kan, Mativenga & Marnewick, 2020). The Climate Action Tracker estimates that, if South Africa continues to act under the business-as-usual scenario, its gas emissions will contribute to increase the global temperatures to between 3 and 4 degrees Celsius (Kan et al., 2020). This indicates the urgent need to put in place mitigative measures that promote cleaner production through GSCM practices. This challenge not only affects all sectors of the South African economy and, the manufacturing sector in particular, but also the well-being of populations. Consequently, it makes sustainable development essential to curb the effect of global warming through the manufacturing sector.

Another challenge that characterises the South African manufacturing sector relates to its inefficiency and ineffectiveness with regard to global competitiveness. The global Economic Forum (2018) ranks South Africa 67 (average score of 60.8) out of 140 countries in terms of competitiveness. This suggests that the country has yet to implement measures that would enhance its long-term growth. South Africa fell five places from 62 in 2017 and second last from its BRICS (Brazil, Russia, India, China and South Africa) counterparts. In addition, the South African manufacturing sector is in decline since the end of Apartheid in 1994. Its contribution to the GDP has been declining year on year and went from above 20 per cent in 1993 to below 14 per cent in 2016 (Statistics South Africa, 2018). This decline indicates that all players of the economy should start investing in practices that promote sustainability alongside economic growth. Hence, South African manufacturing firms must integrate green practices in their supply chains to improve their performance as well as the level of competitiveness of their products in both the local and global markets. As Garbie (2017) points out, South African manufacturing firms have the challenge of streamlining their production activities based on an understanding of the challenges, which focus on the implementation of sustainable supply chain practices. An understanding of these challenges can help firms to improve their global competitiveness.

From a competitiveness viewpoint, one can argue that the South African manufacturing sector is faced with immense and increasing pressure to improve its productivity in order to survive within the global market. Improving the productivity will require the manufacturing sector to enhance its processes and reduce its production costs while maintaining the quality of its products (Ikome, Laseinde & Katumba, 2022). It is also important to note that measuring a nation's competitiveness depends mainly on its capacity and ability to innovate and upgrade its existing production processes which highlight the importance of GSCM and SCDC (Nyam, Bahta, Oduniyi & Matthews, 2022). It is further reported that innovation through green practices can be characterised as a driver of performance in terms of productivity, effectiveness and efficiency, and profitability (Gaglio, Kraemer-Mbula & Lorenz, 2022; Nyam et al., 2022). To this end, the manufacturing sector have to embrace the shift towards sustainable supply chain practices that can help reduce the impact of manufacturing operations on the environment and improve its processes and competitiveness.

Various previous research studies have investigated the effect of GSCM practices on SCP in South African organisations (Niehaus *et al.*, 2018). For example, Mafini and Mposhi (2017) examined the association between GSCM practices, environmental collaboration and financial performance in the South African SMEs. Bag, Gupta and Telukdarie (2018) scientifically reviewed the influence of organisational culture, green supplier development, supplier relationship management, flexibility and innovation on sustainability in supply networks under the moderating effect of institutional pressures and resource availability. Epoh and Mafini (2018) analysed the relationship between GSCM, environmental performance and SCP in South African small to medium enterprises (SMEs). Ganda (2018) evaluated the impact of carbon performance on the firm financial performance within the South African corporate sector for the period 2014 to 2015.

Most of the above studies focussed on the impacts of GSCM on either an individual dimension or all three dimensions of the corporate performance, which include environmental performance, economic/financial performance and social performance, without considering combining these performance dimensions in a single study. Unlike such attempts, the present study integrates these performance dimensions to capture the impact of GSCM within the manufacturing sector holistically. Furthermore, there appears to be a paucity of studies that have considered all GSCM practices and their impact on the DCs and SCP in the South African manufacturing sector as the study attempts to do. Additionally, although it is well established in research that the concepts of GSCM practices lead to higher SCDCs and superior SCP (e.g. Younis *et al.*, 2016; Famiyeh *et al.,* 2018; Kirchoff *et al.*, 2016), there is still a dearth in literature in South Africa concerning the adoption and the implementation of GSCM to achieve sustainable development. Moreover, the area of GSCM is still at an emergent stage in most developing nations such as South Africa and the rest of Africa (Epoh & Mafini 2018). This low-level implementation of GSCM requires that more research be conducted to enable SCM professionals to develop strategies suitable for their organisations, and for scholars to understand and communicate to others the benefits associated with the adoption and implementation of sustainable supply chain practices.

Green supply chain management concepts were developed as a result of environmental sustainability and competitiveness. This suggests that firms in the manufacturing sector must play a role in reducing the impact of their operations on the environment by embracing GSCM. Furthermore, the quest for environmental sustainability creates an incentive for further research studies in the field of GSCM that will lead to the improvement of efficiency up and downstream the supply chain and further enhance the competitiveness of manufacturing firms. To improve their competitiveness and legitimacy across society, organisations need to embrace sustainable practices (PAGE, 2018).

1.4 RESEARCH OBJECTIVES

Theoretical and empirical objectives were formulated to achieve the purpose of the study.

1.4.1 Theoretical objectives

Theoretical objectives involved conducting a literature review of the following topics:

1) The manufacturing sector in South Africa.
2) Research theories which include institutional theory, dynamic capability theory and contingency theory.
3) Green supply chain management (GSCM).
4) Supply chain dynamic capabilities (SCDCs).
5) Supply chain performance (SCP).

1.4.2 Empirical objectives

The following empirical objectives were formulated:

1) Exploring the extent of the implementation of green supply chain management practices (GSCMPs) in the South African manufacturing sector.
2) Examining the effectiveness of supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
3) Measuring the performance of the South African manufacturing sector supply chains.
4) Investigating the influence of green supply chain management (GCSM) practices on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
5) Evaluating the influence of supply chain dynamic capabilities (SCDCs) on supply chain performance (SCP) in the South African manufacturing sector.
6) Developing a research model for the implementation of green supply chain management (GCSM) practices, supply chain dynamic capabilities (SCDCs), and supply chain performance (SCP) in the manufacturing sector.

1.5 RESEARCH QUESTIONS

The current study is designed to examine the implementation of green supply chain management practices, evaluate the role of supply chain dynamic capabilities in developing and strengthening green practices, and determine the level of the supply chain performance in the South African manufacturing sector. The study also examines how these constructs relate to each other. The following research questions were thus formulated:

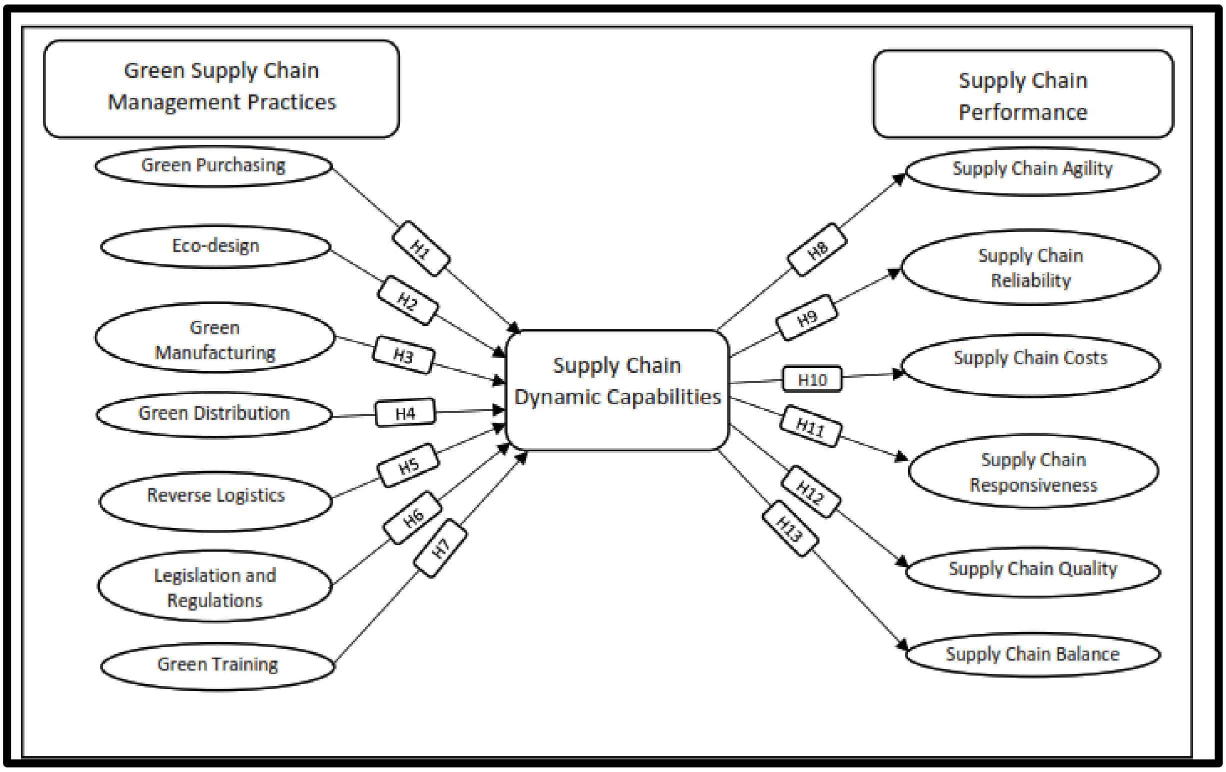
1) What is the extent of the implementation of green supply chain management practices (GSCMPs) in the South African manufacturing sector?
2) What is the effectiveness of supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector?
3) What is the level of supply chain performance (SCP) in the South African manufacturing sector?

4) What is the relationship between green supply chain management practices (GSCMPs) and supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector?
5) What is the relationship between supply chain dynamic capabilities (SCDCs) and supply chain performance (SCP) in the South African manufacturing sector?
6) How green supply chain management practices (GSCMPs) and supply chain dynamic capabilities (SCDCs) interact to produce a higher supply chain performance (SCP)?

1.6 CONCEPTUAL MODEL

Figure 1.1 outlines the theoretical model that guides the current study. The model postulates that the implementation of green supply chain management (GSCM) in the manufacturing sector positively influences supply chain dynamic capabilities (SCDCs), which, in turn, significantly impact the supply chain performance (SCP) of manufacturing firms through supply chain agility (SCA), supply chain reliability (SCREL), supply chain costs (SCCs), supply chain responsiveness (SCR), supply chain quality (SCQ) and supply chain balance (SCB).

Figure 1.1 Theoretical conceptual framework



Source: The author's own compilation.

1.7 RESEARCH THEORIES

Research theories represent the cornerstone of the knowledge creation in the field of interest. It is important to stress that theories on sustainability are a result of the recognition of the strategic importance of the firm's internal and external activities, with the aim of achieving long-term organisational performance through innovative initiatives, and research and development (Touboulic & Walker 2015). Tabaklar *et al.* (2015) allude that, theories play a crucial role in helping the world to understand the phenomenon around it. This section presents the theories underpinning the study to develop a research framework that can contribute to the body of knowledge. A more comprehensive discussion of the research theories is presented in Section 3.2.

1.7.1 Institutional Theory

Institutional theory represents a set of pressures emanating from governmental and other institutional bodies, which are aimed to enforce the adoption and implementation of strategies that are legitimate within a sector of interest (Sang *et al.*, 2013; Windolph *et al*, 2014; Huang *et al.*, 2017). Vanpoucke *et al.* (2016) argue that firms that pursue legitimisation are not proactive in their essence; they rather act reactively to pressures to avoid punitive measures such as fines and penalties, sanctions, clean-up operations among others as a result of non-compliance. The rationale for selecting this theory was that it facilitated the development of this research framework in illustrating how external pressures such as those from the South African Government as well as other regulatory bodies can foster the adoption and implementation of sustainable practices within the manufacturing sector for an improved performance of the supply chain.

1.7.2 Dynamic Capability Theory

Dynamic capability theory derives from the resource-based theory, which mostly focusses on resource development and deployment to match technological development and market demands (Sangari & Razmi, 2015; Lee & Rha 2016). DC is becoming increasingly common in the field of SCM as it facilitates the understanding of customers' requirements as well as fosters communication throughout the entire supply chain (Aslam *et al.*, 2018). The theory has changed the way organisations are managed; it represents a critical success factor for a long-term sustainability that requires companies to possess the ability to sense, learn and understand supply chains (Mandal, 2017). DCT is relevant for the current study because it contributes to capture the use and deployment of strategic resources in the supply chains. Within the context of the current study, DCT is helpful in that it assumes that the implementation of GSCM practices enables the development of core competencies that allows manufacturing firms to deal with volatilities in the environment in which they operate. DCT further provides an opportunity to supply chain professionals to reconfigure their strategies to respond to challenges that may arise from up and downstream of their supply chains and achieve sustainable competitive advantage through agility, reliability, cost, responsiveness, quality and supply chain balance.

1.7.3 Contingency theory

Contingency theory was developed in the late 1960s with the purpose of studying how environmental uncertainties can affect the behaviours of organisations (Hwang & Min, 2015). The theory is premised on the view that organisational strategy is dependent on the business environment. For example, the current unpredictable state of the global economy is prompting businesses to consider other sources of revenues beyond their traditional and well-established markets. In order to succeed, businesses must find a fit between their strategies and the needs and preferences of the new markets. Alves *et al.* (2017) argue that it is crucial that management reconfigures its businesses and adopts the best practices that can adequately help respond to uncertainty. Furthermore, the implementation of best practices can ultimately lead to higher SCP, which is in line with the rational of CT. CT postulates that there is no one best way to measure performance in an organisation since there are too many external and internal constraints that can alter the level of performance in a given situation (Hwang & Min, 2015). In other words, it is the situation at hand that determines the best course of action to take. Hence in the present study, various key factor indicators of performance are used, which include supply chain agility, supply chain reliability, supply chain cost, supply chain responsiveness, supply chain quality and supply chain balance.

A careful consideration of the above theories can facilitate better strategic, tactical and operational decisions within an organisation. Furthermore, these theories can be essential in promoting measures that improve the performance of the supply chains. Promoting these measures can enable companies to attain the level of sustainability required to outperform rivals and achieve competitive advantage. Owing to the application of these theories, the effects of uncertainties and complexity in the supply chain can be mitigated effectively and efficiently through finding the appropriate fit between the organisational strategy and the environment which can eventually lead to an improved performance. Finally, these theories provide SCM professionals with new perspectives to develop new capabilities, skills and new supply chain configurations that can help to respond adequately to changes in a volatile market.

1.8 PRELIMINARY LITERATURE REVIEW

This section provides brief theoretical reviews of the concepts of GSCM and the constructs under consideration in the study. A more extensive review of the literature is provided in Chapters 3 and 4 of the thesis.

1.8.1 Green supply chain management

The practices of GSCM have become the backbone for many organisations as competition increases in the marketplace and consumers are becoming more and more environmentally conscious (Singh *et al.*, 2016). Famiyeh *et al.* (2018) report that GSCM is fundamentally growing as a key component of sustainability within the SCM in that its adoption and implementation improves the competitiveness of the supply chain. In addition, Singh and Sharma (2015) suggest that for firms to enhance the competitiveness of their supply chains, they need to embrace GSCM as it ensures that processes and operations are efficient and sustainable.

The practices of GSCM have evolved over the past few years to the extent of becoming multidimensional resulting in various conceptualisations. Srivastava (2007) defines GSCM as a process of integrating environmental thinking into the supply chain, which includes product and service designs, procurement, manufacturing processes, distribution and end-of-life management of the product to achieve a sustainable competitive advantage. Meixell and Luoma (2015) define GSCM as an integration of processes that enables members of the supply chain to collaborate, share information, knowledge, materials while striving together to achieve their respective goals through the triple bottom line (economic, environmental and social performance). Beamon (1999), as cited by Younis *et al.* (2016:217) also defines GSCM as an extension of the traditional supply chain to include activities that aim at minimising environmental impacts of products throughout its entire cycle, such as green design, resource-saving, harmful material reduction and product recycle and reuse. An observation of these definitions indicates that there is a broad spectrum of applications and conceptualisation of GSCM, which makes it challenging to find a universal, comprehensive framework for the dimensions of GSCM.

Much research on GSCM have focussed on economic, environmental and social performance, with emphasis on either a single dimension or all three dimensions of GSCM (Kafa *et al*., 2013; Luthra *et al.,* 2016; Younis *et al*., 2016; Fang & Zhang, 2017; Epoh & Mafini, 2018; Çankaya & Sezen, 2019). However, few studies on GSCM are devoted to functional areas of the supply chain in the manufacturing sector (Mollenkopf *et al.*, 2010). The study closed the gap by focusing on the implementation of GSCM, dynamic capabilities and supply chain performance in the South African manufacturing sector.

1.8.2 Green supply chain management practices

Green supply chain management practices are activities performed by firms in their supply chains to minimise their impact on the environment (Balasubramanian & Shukla, 2017). Given the fact that sustainability is multidimensional in its scope and etymology, firms should select practices that are deemed necessary for them to improve the performance of their supply chains. The study focussed on seven green supply chain practices, namely: green purchasing; eco-design; green manufacturing; green distribution; reverse logistics; regulations and legislation; and green training. Green practices are of great importance for manufacturing organisations to achieve their strategic goals and maintain the sustainability required for their operations (Migdadi & Omari, 2019).

1.8.2.1 Green Purchasing

Green purchasing (GP) can be defined as a process of integrating environmental thinking into the procurement of materials (Çankaya & Sezen, 2019). According to Fang and Zhang (2018), GP influences the supply chain upstream as the buying organisation communicates to its suppliers the specifications ordered products must meet. This entails that the supplier's selection plays a critical role in helping to achieve organisational goals. The buying organisation and its suppliers must strive to preserve their common interests, minimise the impact of their business activities on the environment and improve SCP.

1.8.2.2 Eco-design

Eco-design (ED) is perceived as a design of new products in such a way as to reduce their impact on the environment throughout their entire life cycle from the procurement of raw materials to their disposal (Fang & Zhang, 2018). ED is a very important stage of manufacturing as it improves efficiency and facilitates the recycling of materials (Epoh & Mafini, 2018). Liu *et al.* (2018) suggest that the design phase has the potential to reduce waste and improve manufacturing costs. Liu *et al*. (2018) further report that 80 per cent of environmental burdens and costs are fixed during the design process. Moreover, the scope of ED includes environmental risk management, product safety, pollution prevention, ecology, material conservation, accident prevention and waste management (Liu *et al.,* 2018).

1.8.2.3 Green manufacturing

Green manufacturing (GM) is defined as a set of activities designed at improving the efficiency of the supply chain and reducing waste during the process of converting raw materials into finished products (Çankaya & Sezen, 2019). The process aims at producing environmentally friendly products to satisfy the needs of consumers, meet environmental requirements and increasing profitability and sustainability. GM incorporates various strategies, drivers and techniques that make the manufacturing processes more efficient, produce products that are safe for consumption and recyclable (Deif, 2011, as cited by Seth *et al.*, 2018).

1.8.2.4 Green distribution

Green distribution (GD) can be described as a process of “integrating environmental concerns into packaging, transportation and logistics activities” (Kafa *et al.*, 2013:71). In addition, Kafa *et al*. (2013) categorise GD into two groups:

- green packaging, which promotes the use of recyclable materials to reduce waste and improve costs and
- green transportation and logistics, which entails optimising routes and orders to save energy and reduce carbon emissions.

Green distribution involves activities that can influence the supply chain in its entirety. It includes all activities that promote the reduction of environmental damages and wastes during shipping (Çankaya & Sezen, 2019). GD further emphasises on the consumption of fuel by vehicles transporting products, the frequency of transportation activities, the distance to consumers and the packaging characteristics that affect GD performance.

1.8.2.5 Reverse logistics

Reverse logistics (RL) can be defined as a process of retrieving used products from the point of consumption to the point of origin for possible reusing, recycling and remanufacturing (Kafa *et al*., 2013:72). RL includes collection, inspection, selection, cleaning, sorting, recycling, recovery, redistribution and disposal of products (Kafa *et al*., 2013). This process in itself helps to achieve ecological balance in supply chains. RL provides numerous sustainable benefits through the return to resell, refurbish, recondition, remanufacture, cannibalise for parts, or recycle products to minimise landfill waste (Morgan *et al.*, 2018). According to Mahindroo *et al.* (2018), product returns constitute 20 per cent of everything sold to customers. Mahindroo *et al*. (2018) further emphasise that, if RL is well managed, it can help cut costs and increase profit margins. Moreover, RL can result in higher financial returns, improved customer satisfaction and increased public perception as a result of handling product returns efficiently and incorporating customer feedback (Mahindroo *et al*., 2018).

1.8.2.6 Legislation and Regulations

It is suggested that legislation and regulations refer to laws, policies and rules that are usually promulgated by governments and other regulatory bodies to promote the preservation of the environment (Epoh & Mafini, 2018:3). Huang *et al.* (2015) allude that firms are highly likely to adopt and implement green practices because of the role LR play in fostering the implementation of sustainable practices. Moreover, Huang *et al*. (2015) point out that organisations are mostly afraid of the consequences of non-compliance with environmental rules and regulations rather than the desire to pursue green strategies. Davis-Sramek *et al.* (2019) suggest that LR provide a roadmap to firms to adapt their strategies and business activities to effectively create harmony in the implementation of sustainable practices and mitigate discrepancies. This entails that firms should pursue the quest towards sustainability, share common values and norms and over time the implementation of green practices can become similar.

1.8.2.7 Green Training

Green training (GT) can be defined as a process of on-the-job training and continued education intended to achieve corporate environmental management targets and purposes (Teixeira *et al.*, 2016:171). Teixeira *et al*. (2016) further suggest that GT enables personnel and top management to think green in exercising their functions with the aim to improve the performance of their organisations. GT provides firms with means that can help to achieve innovative development and improve competitive position. In addition, GT also provides firms with the ability to incorporate dynamic capabilities into its internal processes contributing to building essential elements in the models of competitiveness (Giniuniene & Jurksiene, 2015).

1.9 SUPPLY CHAIN DYNAMIC CAPABILITIES

In the current study, SCDCs and DCs are used interchangeably by the researcher. According to the resource-based view, the competitiveness of a firm is related to its ability to possess unique DCs, which explains the difference in performance among organisations (Kirchoff *et al.*, 2016). DCs are necessary to improve the performance of the supply chains as world economies turn towards the use of digital technologies. The manufacturing sector should not lag, as digitalisation places organisations under intense pressure to continually revitalise their processes and embrace innovation. Hong *et al.* (2018) assert that GSCM and DCs are somehow associated with similar environmental and organisational conditions, making the application of dynamic concepts in the field of GSCM a logical choice. Ju *et al.* (2016) define DC as the ability of an organisation to integrate and organise its internal and external resources. Ju *et al.* (2016) further stress that, organising resources allows firms to create value through mechanisms that are not replicable. Furthermore, DC can enable firms to adjust and adapt to the ever-changing market environment making it an enabler of market dominance through continued implementation of strategies based on environmental changes. Hitt *et al.* (2016) indicate that DCs mostly emphasise on resource development and renewal, making it essential for firms to seek a constant reinvention, build a fast-paced culture and create a driven-based network with other important players in their industry.

Based on the underlying conceptualisation of DCs as elaborated above, SCDC can be perceived as the ability of an organisation to adjust to changes in the entire supply chain. For example, Gimzauskiene *et al.* (2015) highlight that DCs increase the flexibility and agility of an organisation regarding the quick response to the market conditions, especially at times of uncertainty and one can suggest that this provides a valuable link with the performance of the supply chain.

1.10 SUPPLY CHAIN PERFORMANCE

Measuring the performance of an organisation is very important to determine the direction the firm is taking. This process allows management to develop a strategic emphasis of their operations and their implementation. Abdallah, Abdullah and Saleh (2017) argue that it is vital to measure the performance of an organisation as it allows to detect any changes that may occur into the supply chain. SCP is defined as an orderly planned process that enables an organisation to measure the effectiveness and the efficiency of supply chain operations (Neely *et al.*, 1997; Anand & Grover, 2015, as cited by Sundram *et al.*, 2016:1448). Odongo *et al*. (2016), in their study, measure the perceived contribution of a member to the SCP in terms of efficiency, responsiveness, quality and supply chain balance. Christopher (2011), as cited by Kozarević and Puška (2018), uses the following constructs to measure the performance of the supply chain: responsibility, reliability, flexibility and partner relationships.

The study used six constructs to measure the level of performance of the supply chains in the manufacturing sector, namely supply chain agility, supply chain reliability, supply chain costs, supply chain responsiveness, supply chain quality and supply chain balance.

1.11 PROPOSED RELATIONSHIPS BETWEEN GREEN PRACTICES AND SUPPLY CHAIN DYNAMIC CAPABILITIES

The practices of GSCM and DCs are both vital for the success of the supply chain as they allow organisations to achieve flexibility and improved performance (Kirci & Seifert, 2016). Other authors ascertain that the implementation of sustainable practices is dictated by the size of an organisation (Huang *et al.*, 2015; Huang *et al.*, 2017). It is indicated that large organisations are likely to adopt green practices because they possess sufficient, essential resources and capabilities that small organisations do not have (Huang *et al*., 2015; Huang *et al*., 2017). This suggests that DCs play a mediating role in the adoption and implementation of environmental sustainability. Moreover, Kähkönen *et al.* (2018) posit that a mere reaction to environmental pressures may not lead to better DCs. Hong *et al.* (2018); Annunziata *et al.* (2018) argue that combining sustainable supply chain practices (SSCPs) such as GSCM practices with DCs makes organisations more flexible to changes in a dynamic environment while providing at the same time a competitive advantage. Li *et al.* (2019) further ascertain that DCs can positively affect the ability of a firm to commit to green practices. Li *et al*. (2019) also argue that introducing green practices into a supply chain allows the change of existing technologies, processes, or routine activities. Based on these arguments, the following hypotheses were formulated:

H_1: Green purchasing (GP) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H2: Eco-design (ED) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_3: Green manufacturing (GM) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_4: Green distribution (GD) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_5: Reverse logistics (RL) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_6: Legislation and regulations (LR) exert a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_7: Green training (GT) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

1.12 PROPOSED RELATIONSHIPS BETWEEN DYNAMIC CAPABILITIES AND SUPPLY CHAIN PERFORMANCE

There is evidence of a positive relationship between DCs and organisational performance, which is linked to SCP in several previous studies. For example, Kirci and Seifert (2015) used DCT in the SCM context and found that competitiveness in the supply chain is positively related to green initiatives which are stimulated by strong DCs. Giniuniene and Jurksiene (2015), on other hand, argue that the role of DCs in increasing the performance of an organisation is still questionable as there are still unidentified drawbacks and lack of grounded evidence to support the idea. In line with the view of Giniuniene and Jurksiene (2015), some authors (Liao *et al*., 2017; Teece, 2018) argue that DCs need to be strong to influence organisational performance, thereby improving the SCP. This suggests that possessing DCs is not enough to achieve enhanced SCP. In this context, DCs would not influence the performance of the supply chain if they are not developed in the areas of sensing, seizing and transforming and aligned with the overall organisational strategy. Aslam *et al.* (2018) argue that DCs allow firms to sense uncertainties and seize opportunities into their supply chains, thus improving the performance of the supply chains.

Based on research studies above, the present study argues that DCs may enable the success of a supply chain in terms of SCA, SCREL, SCC, SCR, SCQ and SCB. Thus, the study hypothesises that:

H_8: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain agility (SCA) in the South African manufacturing sector.

H_9: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain reliability (SCREL) in the South African manufacturing sector.

H_{10}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain costs (SCCs) in the South African manufacturing sector.

H_{11}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain responsiveness (SCR) in the South African manufacturing sector.

H_{12}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain quality (SCQ) in the South African manufacturing sector.

H_{13}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain balance (SCB) in the South African manufacturing sector.

1.13 DELIMITATIONS OF THE STUDY

This section describes the delimitations of the study. They consist of sample delimitation, geographic delimitation, theoretical delimitation and methodological delimitation.

1.13.1 Sample delimitation

The unit of analysis in the study was restricted to those individuals involved in supply chain activities such as supply chain, quality and operations professionals. They were chosen because of their knowledge of SCM as well as the positions they occupied could greatly influence the decision-making process with regard to sustainability.

1.13.2 Geographical delimitation

The study was mainly conducted in the South African manufacturing sector in Gauteng province and was extended to other provinces, namely Limpopo, Free State and Mpumalanga. The rationale behind this choice was that Gauteng province represents the economic powerhouse of South Africa and it is the centre of local and global businesses, including manufacturing firms. The choice of other provinces (Limpopo, Free State and Mpumalanga) was motivated by their close proximity to Gauteng as well as the fact that they also have various manufacturing companies and suppliers.

1.13.3 Theoretical delimitation

The study tackled GSCM, SCDCs and SCP in the South African manufacturing sector. The dimensions of green practices under consideration consisted of GP, ED, GM, GD, RL, LR and GT. In terms of SCP, the study considered functional areas of the supply chain to measure the performance and the following constructs were used: SCA, SCREL, SCC, SCR, SCQ and SCB. Most of previous studies have focussed on environmental, economic and social dimensions of GSCM and not on operational performance of the supply chain networks. The study closed this gap by focusing on GSCM, SCDCs and SCP.

1.13.4 Methodological delimitation

The study was oriented towards the positivist philosophy (quantitative study) as a result of its ability to provide suitable tools to measure the cause-and-effect relationships among the research constructs objectively.

1.14 LIMITATIONS OF THE STUDY

Due to complexities that come with the probability sampling in terms of time constraints, excessive demand in financial resources, difficulty to find with accuracy a list of all supply chain professionals of manufacturing firms in South Africa, as well as the difficulty to use all information about the target population, the study was cross-sectional. A non-probability purposive sampling approach was used for collecting data.

1.15 SIGNIFICANCE OF THE RESEARCH

The study is conducted in the context of rising trends towards a globalised world, where trade barriers are starting to collapse, despite significant efforts by some nationalist movements to create a global economic turmoil through trade tariffs and duties. An example of the latter is the trade war that exists currently between the United States (US) and China, triggered by the protectionism concept from the US president. The trend towards a single market is presently forcing all sizes of organisations worldwide to reshape themselves through constant reinvention, the anticipation of changes wherever possible and market positioning to remain in the marketplace. In the context of the study, the combination of GSCM and SCDCs was a critical success factor that enabled manufacturing firms in particular, regardless of their size, to adapt their strategies to the dynamic market environment to improve and sustain the performance of their supply chains. Hence, the insights of the study cannot be disregarded as the information generated from it can allow not only supply chain managers and executives to reconfigure their business models but also scholars to understand the concepts of GCSM and SCDCs and promote further research studies in this field. Moreover, the study can contribute to the body of knowledge by providing information on the beneficial outcomes of the adoption and implementation of GSCM practices in manufacturing supply chains within the context of developing countries such as South Africa.

1.16 SUMMARISED RESEARCH METHODOLOGY

Once a study has identified and established the broad approach to the research problem, the next step is to prepare a framework or blueprint of the study, which specifies the procedures necessary for achieving the stated research objectives effectively (Sreejesh *et al.*, 2014:27). This section presents the structure that was used for collecting and analysing data. It describes the research approach, research design, sampling design, target population, sampling frame, sampling size, sampling approach and techniques, data collection method and procedures, data analysis and statistical strategies, data reliability and validity, model fit analysis ethical, considerations and chapter outline. A more in-depth discussion of the research methodology followed in the study is presented in Chapter 5 of the thesis.

1.16.1 Research approach

It is often reported that a research approach (also known as a research method) can be quantitative, qualitative, or mixed-method (Blumberg *et al.*, 2014). In any research study, one faces the task of selecting a specific approach to use since several approach choices exist (*Ibid*). In the context of the current study, a quantitative approach was used as the method of data collection and data analysis. The rationale behind this choice was that the investigation was predictive and causal as it tried to explain the relationships among research constructs.

1.16.2 Research design

Research design constitutes a framework or blueprint for conducting business research project efficiently. It details the procedures necessary for collection, measurement and analysis of information which helps the researcher to structure or solve business research problems (Sreejesh *et al.*, 2014:27). Creswell and Creswell (2017) label research design as experimental, causal-comparative, survey and correlational designs. The study used a combination of correlational and survey research designs as it intended to establish the causal relationships between variables of interest by collecting data using a questionnaire.

1.16.3 Research methods

Research methods can be either observation studies, correlation research, developmental designs, or survey research (Leedy & Ormrod, 2015). Survey research involves acquiring information about one or more groups of people – perhaps about their characteristics, opinions, attitudes, or previous experiences by asking them questions and tabulating their answers (*Ibid*).

The study adopted a survey design using a questionnaire as a method of data collection and was carried out once at one point in time. The survey questionnaire was designed because of its ability to gather extensive data from a large sample of respondents in a relatively quick, easy, and cost-effective manner (Leedy & Ormrod, 2015). Data were collected from supply chain, operations and quality management professionals of the South Africa manufacturing sector in Gauteng, Free State, Mpumalanga and Limpopo provinces. The research design was twofold: the review of literature deriving from secondary data and the empirical study from the collection of primary data (supply chain professionals, operations professionals and quality management professionals).

1.16.4 Time horizon

Research data can be collected in a single period of time (cross-sectional studies) or over an extended period – longitudinal studies (Blumberg *et al.,* 2014). The study was cross sectional since it was conducted once in a single period of time. This choice was motivated by the fact that cross-sectional studies allow a researcher to compare all variables of interest at the same time or unique moment in time. Furthermore, a snapshot does not consider what event happens before and after the data have been collected.

1.16.5 Literature review

A review of literature dealing with the concepts relevant to the study was carried out to address the theoretical research objectives deriving from the research questions. Furthermore, the literature discussed the concepts of GSCM, GSCM practices, the concepts of DCs and the performance of the supply chain. The data for the literature review were obtained from sources that include academic databases such as Emerald, Science Direct, JStor, Sabinet and other credible internet sources such as official reports and research papers. The same sources of data were used for the critical literature review. Moreover, materials such as books, magazines and other organisational records were also used as sources of the literature.

1.16.6 Empirical study

This section comprises the sampling design, the methods of data collection, the analysis of collected information and the data reliability and validity.

1.16.6.1 Sampling design

Sampling design is a procedure that enables the researcher to reduce the amount of data needed to collect by selecting a subset rather than all possible elements that form part of the population (Leedy & Ormrod, 2015). This exercise allows the researcher to draw inferences through the relationships between variables. Owing to this perspective, the sampling design in the current study consisted of population, target population, sampling frame, sample size and sample approach and technique.

1.16.6.2 Population

A population can be defined as the entire collection of elements of which the researcher wishes to draw conclusions (Blumberg et al., 2014). The population of interest in the study consisted of supply chain professionals (supply chain, operations, and quality management professionals) in the South African manufacturing sector.

1.16.6.3 Target population

The target population can be defined as the level at which the research is performed, and which objects are researched (Blumberg *et al.*, 2014:172). In the current study, the target population consisted of supply chain, operations and quality management professionals in the South African manufacturing sector in Gauteng, Free State, Mpumalanga and Limpopo provinces.

1.16.6.4 Sampling frame

A sampling frame refers to the list of elements from which the sample is drawn (Blumberg *et al.*, 2014:183). The current study had no sampling frame as respondents to the study were selected purposively from the South African manufacturing sector in Gauteng, Free State, Mpumalanga and Limpopo. Yellow pages, which is an online platform and a directory for business advertisements was used to identity manufacturing firms within the regions of interest.

1.16.6.5 Sample size

The sample size is the number of elements that forms a subset of the population of interest (Sreejesh *et al.*, 2014). The current study used historical evidence which consisted of observing and presenting sample sizes used in previous research studies on GSCM to determine the size of the sample. Table 1.1 portrays few historical pieces of evidence of studies conducted on GSCM, the sample size used, as well as the models adopted for the analysis.

Table 1.1 Sample size and analytical models of previous studies conducted.

Construct	Previous studies (Authors)	Country	Sample size used	Sample selection strategy	Analytical model
Green Purchase	Çankaya and Sezen (2019:100)	Turkey	281	Probability Sampling (random sampling)	Structural Equation Modelling
	Ghosh (2019)	India	80	Probability Sampling (random sampling)	Confirmatory Factor Analysis
Eco-design	Kirchoff *et al.* (2016:272)	US	367	Nonprobability Sampling (convenience sampling)	Structural Equation Modelling
	Fernando *et al.* (2016: 221)	Malaysia	95	Probability sampling (random sampling)	One-way Analysis of Variance (one-way ANOVA)
	Liu *et al.* (2018)	China	216	Probability Sampling (random sampling)	Structural Equation Modelling
Green Manufacturing	Choi *et al.* (2018: 1029)	South Korea	322	Probability Sampling (random sampling)	Structural Equation Modelling
Green distribution	Hong *et al.* (2018:3509)	China	209	Probability Sampling (random sampling)	Structural Equation Modelling
Reverse Logistics	Morgan *et al.* (2016: 297)	US	267	Probability Sampling (random sampling)	Structural Equation Modelling
	Mahindroo *et al.* (2018: 550)	India	306	Nonprobability Sampling (convenience and snowball sampling)	Moderated Regression Analysis
Legislation and regulations	Huang *et al.* (2015:85)	China	202	Probability Sampling	Descriptive and Analysis

Construct	Previous studies (Authors)	Country	Sample size used	Sample selection strategy	Analytical model
				(random Sampling)	of Variance (ANOVA)
	Choudhary and Sangwan (2018:3631)	India	233	Probability Sampling (random sampling)	Exploratory Factor analysis and Cluster Analysis
Green training	Teixeira *et al.* (2016)	Brazil	95	Probability Sampling (random sampling)	Structural Equation Modelling
Supply Chain Dynamic Capabilities	Dias and Pereira (2017:420)	Portugal	207	Probability Sampling (random sampling	Exploratory Factor Analysis and Reliability Analysis
	Lee and Rha (2016:3)	South Korea	316	Probability Sampling (random sampling)	Confirmatory Factor Analysis and Structural Equation Modelling
Supply chain performance	Odongo *et al.* (2016:1785)	Uganda	150	Nonprobability Sampling (judgemental and snowball sampling)	Structural Equation Modelling
	Sundram *et al.* (2016:1447)	Malaysia	156	Probability Sampling (random sampling	Sobel test, Bootstrapping approach and Confirmatory Factor Analysis

Source: Author's own compilation

Table 1.1 indicates that the minimum sample size is 80 respondents and the maximum 367 respondents, giving an average of 235 respondents. Based on these previous studies, the sample size for the present study was 402 respondents, which was deemed satisfactory since small samples sizes may have impacted the statistical significance of the study.

1.16.7 Sampling approach and technique

A non-probability sampling is a process in which the decision regarding the sampled elements is left to the researcher, based on criteria which include the knowledge of the research issues, or the capacity and willingness to participate in the study (Apostolopoulos & Liargovas, 2016). The study adopted a non-probability purposive sampling since the selection of research respondents was left at the discretion of the researcher. A purposive sampling is a research selection process in which respondents are chosen based on their suitability to meet the research objectives (Leedy & Ormrod, 2015). The knowledge of supply chain and operations management was the prerequisite of being selected in the study and a purposive sampling was used because it is cheaper and easy to find respondents.

1.16.8 Data collection method and procedure

The collection of data can be defined as a process of acquiring facts from the study's environment to find answers to the research problems (Blumberg *et al*., 2014). A self-administered survey questionnaire was used to collect data. This method is cheaper and allows respondents to answer questions at their convenience and anonymity. The questionnaire was pilot tested using a small group of respondents for weaknesses and ambiguities. This exercise helped respondents to get familiarised with the research protocol and understand research expectations. The feedback from the pilot test allowed the researcher to refine the questionnaire through the removal of all shadow areas for clarity before the effective commencement of data collection.

The questionnaire comprised five sections: Section A elicited information about the profile of South African manufacturing companies participating in the study. Section B elicited information related to the demography of respondents, while Section C requested information regarding GSCM practices. The questions of section C were adapted from Laosirihongthong *et al.* (2013), Kirchoff *et al.* (2016), Morgan Richey Jr and Autry (2016), Younis *et al.* (2016), Nejati Rabiei and Jabbour (2017), Choudhary and Sangwan (2018), Jasmi and Fernando (2018), Çankaya and Sezen (2019) and Liu *et al.* (2020). Section D attempted to find responses on SCDCs, and the questions were adapted from Hong et al. (2018). Section E questions were adapted from Sindhuja (2014), Huo *et al.* (2016), Song and Liao (2018), Sundram *et al.* (2016), Delic *et al.* (2019), Yu *et al.* (2019) and Peng *et al.* (2020) and were used to measure the performance of the supply chain. Section C to Section E were presented in a five-point Likert scales anchored by 1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree. More details about the measurement scales used in the study and their validation are presented in Section 5.9.2.

1.17 DATA ANALYSIS AND STATISTICAL APPROACHES

Data analysis is the interpretation of information collected using analytical tools and techniques according to the requirements set by the researcher (Sreejesh *et al.*, 2014: 27). The collected data were examined through descriptive and inferential statistics.

1.17.1 Descriptive statistics

Descriptive statistics is a process that describes the data numerically (Blumberg *et al.*, 2014). Data collected from Sections A and B which sought to establish the profile of South African manufacturing companies participating in the study and the demographic characteristics of its respondents were analysed using descriptive statistics which included frequency distributions, mean, standard deviations and percentage.

1.17.2 Inferential statistics

Inferential statistics is the process that allows a researcher to draw inferences about large populations from relatively small samples (Leedy & Ormrod, 2015). Data collected from Section C to Section E of the questionnaire in Appendix 1 of the proposal, which attempted to test hypotheses were analysed using inferential statistics. In the present study, statistical software packages namely Statistical Package for Social Sciences (SPSS version 25.0) and Smart-Partial Least Squares (Smart-PLS 3) were used to analyse data obtained from various respondents through survey questionnaires. The relationships between the research constructs were determined using Structural Equation Modelling (SEM). Confirmatory Factor Analysis (CFA) was used to test the accuracy of the measured variables. The exercise helped in determining the model fit and answering research questions.

The fit assessment was determined through the goodness-of-fit tests which aimed at establishing the extent to which the distribution of a variable follows some pre-specified functional form in the population (Lin *et al.*, 2017). In the current study, the fit was assessed through Normed Fit Index (NFI) and standardised root mean square residual (SRMR) using Smart-PLS 3.

1.18 DATA RELIABILITY AND VALIDITY

It is important in any research project to ensure that the measurements obtained from an instrument are of good quality. Reliability and validity were used to evaluate the psychometric properties of the measurement scales.

1.18.1 Reliability

Reliability can be defined as the consistency or the stability of a measure. Zhong *et al.* (2017:108) argue that a measure is of high reliability if it produces similar results under consistent conditions. Cronbach alpha coefficient, Composite Reliability (CR), Rho_A and Total-Item correlations were used to test internal consistency since the study intended to evaluate the homogeneity, reproducibility and the stability of the measures. The item-total correlation coefficient was higher than 0.30 (Seydi *et al.*, 2021; Ozsahin & Derya, 2022), the Cronbach alpha coefficient was also greater than the recommended score of 0.60 (Ferine *et al*., 2021; Kholed *et al.*, 2021), the Rho_A was greater than the recommended value of 0.70 (Van Nguyen & Habok, 2021) and the Composite reliability was great than 0.70 (Hernández-Perlines, 2019; Kholed *et al*., 2021).

1.18.2 Validity

The validity refers to the level of accuracy of an instrument to measure what it is supposed to with effectiveness and correctness (Zhong *et al.*, 2017). Alves *et al* (2017) ascertain that validity can be established through face validity, content validity, convergent validity and discriminant validity. A pilot test included a small sample of respondents which consisted of a quality manager, a managing director and a logistics manager to determine the validity of the questionnaire. Face validity and content validity were analysed through the review of the questionnaire by supply chain professionals with intensive knowledge in SCM. Convergent validity was established through factor loading of items and the AVE (Kholed *et al*., 2021). Factor loadings greater than 0.50 were desirable (Lestari, 2019) as well as AVE that exhibited values equal or higher than 0.50 (Fadhel *et al.*, 2019). In order to evaluate the discriminant validity of constructs in Smart PLS model, the Fornel and Larcker criterion was used to compare the square root of each AVE in the diagonal with the correlation coefficients for each construct in the relevant rows and columns (Çakıt *et al*., 2020).

1.19 ETHICAL CONSIDERATIONS

This section provides a brief overview of some ethical issues as described by Yuko and Fisher (2015) that were addressed before and during the data collection process. These ethical considerations are discussed in greater depth in Section 5.14.

- **Informed and voluntary consent**

Respondents were provided with information necessary to ensure they can make an informed decision to accept or to reject their participation in the study. Potential risks such as discomfort, depression, embarrassment, loss of respect, violation of company's protocols, among others were disclosed to respondents. Participation in the study was on a voluntary basis and respondents were allowed to withdraw from the research at any time without reprisal.

- **Right to privacy and confidentiality**

The privacy, confidentiality and dignity of respondents were protected throughout the study by respecting the confidentiality agreement. Respondents to the study were not required to disclose their names or any other information that could help identify them. Research data were not disclosed to the public or unauthorised persons.

- **Protection from harm**

Respondents were not exposed to conditions that could affect their psychology (i.e., emotional stress) or their daily routine activities.

- **Ethical clearance**

Ethical clearance was granted by UNISA Graduate School of Business Leadership before the collection of data commenced.

- **Thesis integrity**

All sources of information, such as books, articles, magazines, were acknowledged through referencing.

1.20 DEFINITION OF TERMS

- **Manufacturing sector**

Manufacturing refers to the process involving the production of goods that converts raw materials into intermediary or final goods using labour, tools and machinery to sell these products to the local or international markets (Sunjka & Emwanu, 2015). The South African manufacturing sector as defined by the South African Government comprises 10 industries namely the automotive industry, the metal industry, the textile, clothing and footwear industry, the agri-food industry, the chemicals industry, the wood, paper and printing industry, the information and communication technology and electronics industries, the electrical and machinery industry, the glass and non-metallic industry and the furniture and other manufacturing industries (Statistics South Africa, 2018).

- **Supply chain management**

SCM describes the management of all activities in the supply chain networks from the acquisition of raw materials to the distribution of final products to consumers (Gurtu *et al.*, 2015; Talatappeh & Lakzi, 2019).

- **Green supply chain management**

Based on the review of definitions by Roehrich *et al.* (2017), Kazancoglu *et al.* (2018), Maditati *et al.* (2018) and Tseng *et al.* (2018), the current study defines GSCM as a set of practices that aims at reducing the impact of supply chain activities on the environment while promoting performance improvement for all members of the supply chain networks.

- **Green supply chain practices**
- Green supply chain practices (GSCMPs) are considered as actions aimed at reducing the impact of business operations on the environment, therefore, bringing green value to the entire supply chain (Zaid, Jaaron & Bon, 2018). GSCMPs include GP, ED, GM, GD, RL, PR, LR and GT.
    - Green purchasing (GP) can be defined as supply chain activities which include environmental requirements consisting at ensuring that products purchased have less negative impact on the environment and meet the purchaser requirements (Song *et al.*, 2016; Younis *et al.*, 2016).

    - Eco-design refers to the extent to which the firm’s production activities cause minimum damages to the environment. The design process involves, easy assembly and disassembly, remanufacturing or recycling and friendly disposal of products after their end-of-life cycle (Al-Sheyadi *et al.*, 2019).

- Green manufacturing describes the process of producing goods or services that are in line with environmental requirements throughout the entire life cycle of the products while promoting the sustainability best practices (Hsu *et al.*, 2016).

- Green distribution refers to as supply chain activities aimed at reducing or eliminating the negative effects of operations on the environment during the shipment process. These activities include fuel consumption during transportation, frequency of transportation activities and travelled distances (Çankaya & Sezen, 2019).

- Reverse logistics activities describe a process of recycling, repossessing, remanufacturing, or disposing products collected from consumers in a safe and friendly manner (Hsu *et al*., 2016; Gu *et al.*, 2019).

- Legislation and regulations can be defined as policies and programmes developed by governments and other institutional bodies to ensure compliance of business actors with environmental requirements (Huang *et al.*, 2015).
- Product returns can be characterised as a process of returning products to a retailer or a manufacturer because of their end-of-use, end-of-life, repair, or warranty conditions (Shaharudin *et al.*, 2019).

- Green training is defined as skill development in green initiatives that allows employees to participate effectively in the battle against the pollution of the environment (Xie *et al.*, 2020).

- **Supply chain dynamic capabilities**

Supply chain dynamic capabilities are defined as the ability of a firm to utilise its existing competencies effectively and efficiently, explore other relevant competencies, exploit inefficiencies in supply chains, adjust business models and foster technological innovation (Teece, 2017; Martin & Bachrach, 2018; Mousavi *et al.*, 2018; Neise & Diez, 2018).

- **Supply Chain Performance**

Supply chain performance can be defined as operational activities designed to improve the performance of the SCNs as well as that of supply chain members (Odongo *et al.*, 2017; Lima-Junior & Carpinetti, 2019). The performance of the supply chain is measured in the study in terms of SCA, SCREL, SCCs, SCR, SCQ and SCB.

- Supply chain agility refers to the ability to adjust and adapt strategies and competencies timeously to respond to changes in the supply chain (Gölgeci *et al*., 2019).

- Supply chain reliability represents the ability to perform task as expected (Lima-Junior & Carpinetti, 2019).

- Supply chain costs represent expenses incurred in operating supply chain processes and include, labour costs, material costs, management and transportation costs (Lima-Junior & Carpinetti, 2019).

- Supply chain responsiveness refers to the speed in which product requests are resolved resulting in satisfaction (Odongo *et al.*, 2017).

- Customer satisfaction can be described as an emotional connection that is established between a customer and a manufacturer as a result of a satisfactory experience for its offerings (Udofia *et al.*, 2020).

- Supply chain quality refers to the ability to deliver on quality requirements which include safety, product quality (Geyi *et al.*, 2019).

- Supply chain balance refers to the distribution of risks and benefits throughout the supply chain network (Odongo *et al*., 2017).

1.21 CHAPTER OUTLINE

This section outlines the organisation of the research thesis chapters.

Chapter 1: Introduction and background of the study

Chapter 1 discusses the introduction to the manufacturing sector and green supply chain management and the research background. It further elaborates on the thesis statement, the problem statement related to the issues faced by the South African manufacturing sector, the statement of the research questions, the research objectives and finally, three theories upon which the present study is built.

Chapter 2: A literature review on the Manufacturing Sector in South Africa

Chapter 2 provides a literature review on the dynamics of the manufacturing sector across the global sphere with much and greater emphasis on the South African context. Furthermore, it discusses the South African institutional background, the manufacturing pre-and post-Apartheid as well as five industries within the manufacturing sector. The chapter further discusses the South African legislative framework, the contributions and challenges of the manufacturing sector.

Chapter 3: Theoretical framework and Literature review on green supply chain management

Chapter 3 discusses three theories which include institutional theory, dynamic capability theory and contingency theory that were identified and found important to guide the study. It further examines green supply chain management and its selected practices, its drivers and challenges as well as its importance in the manufacturing sector. Moreover, the chapter provides a research gap analysis of previous studies on GSCM as well as some evidence of studies conducted on GSCM in the manufacturing sector in international and South African contexts.

Chapter 4: A literature review on supply chain dynamic capabilities and supply chain performance

Chapter 4 presents a literature review on SCDCs and SCP. It further develops an explanatory theoretical framework of GSCMPs and SCDC that translate to higher SCP. The proposed conceptual framework explores the possibility of developing internal and external dynamic competencies through the implementation of green practices to uplift the performance of the supply chain networks. The chapter further formulates hypotheses emphasising on the relationships between GSCMPs, SCDCs and SCP.

Chapter 5: Research Methodology

This chapter highlights the research philosophy, research approach, research design, approach to sampling and data collection instrument. It further discusses data analysis methods and techniques, model fit analysis and ethical consideration.

Chapter 6: Data Analysis and Interpretation of Results

This chapter presents the data analysis and the interpretation of results. It is further divided into three sections: the first section discusses the results of the pilot study. The second section distils descriptive statistics through measures of mean, standard deviation, correlation as well as the reliability and validity analysis with respect to green practices, SCDCs and SCP. The third section presents inferential statistics through CFA and tests of the proposed hypotheses. This chapter also discussed research findings with reference to the research objectives and problem statement.

Chapter 7: Conclusions, recommendations, limitations and implications for future research.

This chapter draws conclusions based on the statistical analysis and recommendations are provided with regard to the appropriate strategy to deploy in order to improve the performance of the supply chain in the South African Manufacturing sector.

1.22 CHAPTER SUMMARY

The present chapter provided a comprehensive introduction of the manufacturing sector across the world with much emphasis on the South African context. In addition, the chapter presents the background of the study. It also presented the research problem, thesis statement, research objectives and questions. The thesis statement highlighted the slow pace of the manufacturing sector to transition to green manufacturing. The problem statement illustrated the challenges faced by the South African manufacturing sector with regard to environmental pollution and inefficiency. The chapter further outlined the research theories and conceptual framework that guides the current study. A preliminary literature of GSCM practices, SCDCs and SCP was provided and the relationships between the constructs of interest were briefly discussed, and hypotheses formulated. Moreover, the chapter provided the delimitations, limitations and significance of the study. A summary of the research methodology was presented, followed by the definitions of terms, ethical considerations and chapter classification. The next chapter presents a review of the literature on the manufacturing sector in South Africa.

CHAPTER 2

THE MANUFACTURING SECTOR IN SOUTH AFRICA

2.1 INTRODUCTION

This chapter aims to provide a literature review on the dynamics of the manufacturing sector across the global sphere with much and greater emphasis on the South African context. It is essential to discuss the manufacturing sector in the present study, as it represents one of the most influential components to drive economic expansion and prosperity. It is endowed with an exceptional opportunity to create jobs, sustain economic growth, foster trade expansion and reduce poverty and socioeconomic imbalances, especially in developing countries such as South Africa. Owing to the strategic importance that the manufacturing sector plays in the social development and economic growth of any given economy, this chapter first discusses the global perspective of the manufacturing sector within which world noteworthy developments are discussed as well as five industries. It also discusses the South African manufacturing sector by starting with the institutional background, the manufacturing pre-and post-Apartheid and five industries within South African manufacturing. The chapter further discusses the South African legislative framework, the contributions and challenges of the manufacturing sector. Moreover, it describes a few studies in GSCM conducted in the South African manufacturing sector. The chapter concludes with a constructive discussion on environmental sustainability within the South African manufacturing sector.

2.2 THE MANUFACTURING SECTOR: THE GLOBAL PERSPECTIVE

This section elaborates on some critical aspects of the manufacturing sector. It further discusses noteworthy developments in the sector, its contributions to the global economy and the major industries of this vital player of the economy.

2.2.1 Major developments in the global manufacturing sector

An industrial sector comprises three main sectors, namely the manufacturing sector, the mining sector and the construction sector (Mijiyawa, 2017). It is also suggested that of all three industrial sectors, the manufacturing sector has an excellent opportunity to create jobs, sustain long-term growth and eradicate social instability and poverty (*Ibid*). The manufacturing refers to the process involving the production of goods that converts raw materials into intermediary or final goods using labour, tools and machinery to sell these products to the local or international markets (Sunjka & Emwanu, 2015).

In literature, several authors have identified the manufacturing sector as a notable engine of economic development and growth (Chikabwi *et al.*, 2017; Bag *et al.*, 2018; Okolo, 2018). According to Chikabwi *et al.* (2017), it is evident from the advanced economies that the manufacturing sector in terms of sectoral percentage, contributes far beyond all other players of the economy to the gross domestic product (GDP) worldwide. The world manufacturing sector was stable in 2018, with a growth rate of 3.9 per cent (United Nations of Industrial Development Organisation [UNIDO], 2019). According to UNIDO (2019), the manufacturing growth slowed down in 2019 due to the trade war between the United States of America (USA) and China, which are the two super world economic powers. Bag *et al.*, (2018), Seth *et al.* (2018) and Linke *et al.* (2019) suggest that the manufacturing sector is an essential component of a society that drives the economy and wealth as well as represents the greatest employer. Seth *et al*. (2018) further argue that the outstanding contribution of the manufacturing sector to the GDP is the result of the synergetic relationships with other important players of the economy such as mining, trading, supply chains, financial and even service industries.

The manufacturing sector has been historically the principal source of innovation in the modern economy (Mijiyawa, 2017). Research and development in the manufacturing sector have been the driving force of technological developments in world economies (*Ibid*). Tan *et al.* (2018) also suggest that the manufacturing sector is defined by its ability to promote competition among members of the same industry. It is stressed that competing firms need to have sound strategies that will allow them to improve their manufacturing capabilities since the demarcation lines between industries of this sector are becoming more and more blurred (*Ibid*). This suggests that manufacturing companies, as a whole need to reshape their strategies and develop roadmaps for their businesses to tackle step by step new opportunities, increase their market share and remain profitable. For example, Fernando Gonzalez, the Chief Executive Officer of CEMEX argues in the KPMG report (Global Manufacturing Outlook, 2018) that in the manufacturing sector, the biggest winners will be those manufacturers which strategically embrace and use cutting-edge digital technology to create more value to their products or services rather than those that merely pick it up tactically as their next cost-reduction tool. This simply implies that long-term initiatives need to be taken and business models changed in order to drive the sustainable development of the manufacturing sector. Tan *et al.* (2018), in their study, opine that, four components comprise the manufacturing capabilities, which consist of quality, flexibility, dependability and cost. Moreover, it is suggested that these components help to determine the performance of an organisation (*Ibid*). The next subsection discusses the world's major manufacturing industries.

2.2.2 Major world manufacturing industries

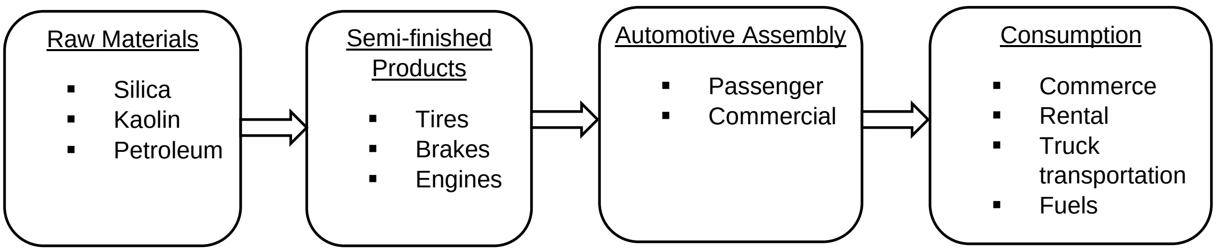
This section discusses the importance and significance of the roles played by various industries that form part of the manufacturing sector in shaping the socio-economic development of any given country. The discussions mostly focus on five main industries, namely the Automotive, Textile and Clothing, Agri-food, Iron and Steel and finally the Information and Communication Technology industries that the researcher has identified as key success factors to reduce unemployment, stimulate the economic growth, promote competitiveness and sustainability. In addition, the researcher used his own discretion to include the steel industry. These industries contribute to strengthen the global GDP. For example, the average annual turnover of the world automobile industry is estimated to be more than 2.75 trillion Euro, which corresponds to 3.65 per cent of the world GDP (Saberi, 2018). The Textile and Clothing market is estimated at 1.7 trillion U.S. dollars which makes approximately 2 per cent of the world GDP (Textile Magazine, 2017). The food and beverage industry represents one of the largest in the world manufacturing sector in terms of job creation and value added in most economies contributing 77.5 trillion U.S. dollars globally in 2017. In 2017, its total global disposable income accounted for 65 per cent of the total world GDP (51 trillion U.S. dollars in 2017) while consumer expenditure represented 56 per cent of the world GDP. Consumer expenditure on food and beverages was 6.6 trillion U.S. dollars or 8.5 per cent of world GDP in 2017 (Food stuff Africa, 2017). The steel industry has a gross value added of 500 billion U.S. dollars, which is 0.7% of global GDP and employs just over 6 million people. The overall impact of the steel industry is 2.9 trillion U.S. dollars value added, and 96 million jobs globally (Askerov, 2019). Finally, in 2021, the Information and Communication Technology industry contributed 4.5 trillion U.S.

dollars to the global GDP, which makes up 5 percent of global GDP overall (Statista, 2023). This statistic provides sufficient evidence that prompted the researcher to select these industries.

2.2.2.1 Automotive industry

The automotive industry is recognised worldwide as one of the pillars of socioeconomic development because of its ability to generate jobs, incomes as well capital investments (De Mello *et al.*, 2016; Pollio & Rubini, 2018; Nazir & Shavarebi, 2019). Furthermore, the industry plays a major role in contributing to archive short and long-term objectives as it represents one of the largest industries in the manufacturing sector across the world (Rajahonka & Bask, 2015; De Mello *et al.*, 2016). It is also evident that this industry also plays a pivotal role in providing linkage with other industries up and downstream of the supply chain networks (Lin *et al.*, 2018; Alvarez *et al.*, 2019). The automotive industry converges various raw-material industries (silica, kaolin, petroleum, among others), intermediate processed products (glass, plastic, steel) and semi-finished products (brakes, tyres, engines) as portrayed in Figure 2.1 (Alvarez *et al.*, 2019).

Figure 2.1 Automotive Supply Chain Network



Source: Adapted from Alvarez et al. (2019).

Figure 2.1 illustrates the convergence of various industries into the automotive supply chain networks from the sourcing of raw materials to the design and production of semi-finished products. At the assembly point, two categories of vehicles are produced, which consist of passenger and commercial vehicles. The vehicles are then distributed through marketing for consumption.

A study by Alvarez *et al.* (2019) indicates that the average growth rate of the automotive industry globally was at 26 percent between 1995 and 2016. This is a clear demonstration of the central role that this industry plays in the world economy.

Furthermore, according to the authors, the economic impact of this industry rises to 2.9 billion dollars and employs eight percent of the world's active population with a production amounting to 95.6 million automobiles worldwide per year. The rapid technological development in this industry is highly intensive and has driven automakers to rethink their business strategies to meet the requirements of the growing demand in the global market (Athanasopoulou *et al.*, 2019; Nazir & Shavarebi, 2019). Moreover, the focus on new technologies has led to increased competitiveness across the world and critical changes in business models aiming at creating, delivering and capturing value propositions to customers (Garza-Reyes *et al.*, 2014). Wilhelm and Dolfsma (2017) argue that firms which pursue innovative strategy are more likely to gain higher innovative performance and competitive advantage.

2.2.2.2 Textile and clothing industry

Since the removal of quota restrictions and other forms of trade barriers in 1995 by world economies as well as the increase in globalisation, the global textile and clothing industry has seen the rise of competition between developed and developing nations (Mair *et al.*, 2016). Mair *et al*. (2016) suggest that it is evident that the collapse of trade barriers has allowed substantial movements of technologies, low skill and labour-intensive activities into the supply chains of the textile and clothing industry. The increased competition for low-cost labour has shifted the production of garments to developing countries. For example, the Bangladesh economy has received a boost from its textile industries as it represents 82 per cent of its total export earnings, ranking the country as the world's second-largest exporter of clothing after China. Bangladesh textile industries currently have an annual export value of nearly 28 billion USD (Hossain *et al.*, 2018). It is expected that the annual ready-made-garments export value will reach about 50 billion USD by 2021 (*Ibid*).

The geographical shift towards developing nations has generated issues of human exploitation through low wage rates, poor working conditions, absence of labour rights for workers and low safety standards (Yang & Su, 2015; Mair *et al.*, 2016). Despite the issue of poor working conditions in less developed nations, it is crucial to note that after the food industry, the textile and clothing industry has been recognised as the second largest manufacturing industry in the world (Paras & Curteza, 2018). The textile and clothing industry plays an essential role in the economic development of emerging countries in particular as well as in those of advanced nations as the industry contributes to creating wealth and generates employments (Mair *et al.* 2016; Pinheiro *et al.*, 2019).

Moreover, Filho *et al.* (2019) emphasise the benefits that this industry provides, such as the promotion of trade agreements, the creation of jobs, investment opportunities, revenue generations as well as opportunities for small business to enter the market through the recycling of wastes and many other small business activities. Filho *et al*. (2019) further indicate that, in 2015, the global market of textiles reached the cap of 1685 billion dollars. Paras and Curteza (2018) and Pinheiro *et al.* (2019) affirm that the global consumption of the textile and clothing industry is estimated to be more than 30 million tons per annum. Worldwide, the textile and clothing industry represents the second largest denim manufacturer, the third in the production of knitwear and the fifth largest industrial park, as well as a reference in beachwear, jeans wear and home wear (Neto *et al.*, 2019).

2.2.2.3 Agri-food industry

The agri-food industry is considered as a constituent part of the manufacturing sector and is an influential pillar for the world's economic development (Miranda *et al.*, 2019; Muñoz-Villamizar *et al.*, 2019). The authors affirm that the industry possesses a large percentage of the total manufacturing value added in most countries around the world and absorbs the largest pool of active workers while contributing considerably to the GDP of many nations. For instance, the Greek's agri-food industry alone contributes 7.2 per cent to the total gross value added and accounts for 15 percent of the overall employment rate (Kafetzopoulos & Skalkos, 2018). In the European block, for instance, the food industry represents 14.5 per cent of total manufacturing revenues, creates 15.5 per cent of the employment and contributes 12.5 per cent to value-added in manufacturing (Cagliano *et al.*, 2016).

The role that the agri-food industry plays in the lives of people cannot be underestimated. It ensures that agri-products destined for consumption are safe and healthy as they are directly related to people's health and social development (Wang *et al*., 2017). Moreover, Zhao *et al.* (2019) stress that the industry plays a leading role in ensuring that the demands of consumers are met in terms of the availability of agri-products as well as maintaining quality and safety. Cillo *et al.* (2018) argue that the advent of globalisation has triggered constant changes in the consumer's needs.

According to the authors, due to the evolving needs, consumers tend to demand products that address diet concerns such as organic products, low-fat products, low-carb content products, among others and also seek products that eliminate unhealthy ingredients based on their level of sensitivity to the products as well as their personal convictions.

The challenges related to the economy (commercial margins), ecology and society (growing demand of food and food security) faced by the agri-food industry prompted manufacturers of this industry to remodel their strategies and start investing in technological development to archive sustainability henceforward, making the industry very competitive (Corallo *et al.*, 2018; Grau & Reig, 2018; Miranda *et al.*, 2019). The authors also argue that the agri-food industry has benefited from the rapid technological advancement of the manufacturing sector in general. Cillo *et al.* (2018) concur that technological development has become increasingly important in the industry as it witnesses rapid growth in a number of innovative projects.

2.2.2.4 Iron and Steel industry

The Iron and steel industry is recognised as an essential driver of the national economic development (Gao *et al.*, 2018; Mehmanpazir *et al.*, 2019; Wang *et al.*, 2019). This assertion is also supported by Kumar and Maiti (2017), who reiterated that the iron and steel industry is crucial for the development of the modern economy and that steel products are considered as the backbone of human civilisation. Moreover, the level of consumption of steel per capita is viewed as an indication of socio-economic development of any given country (*Ibid*). Mehmanpazir *et al.* (2019) suggest that promoting the growth and development of the industry will automatically translate to the growth of the global economy and foster the return to prosperity. The authors further assert that the steel demand is growing as a result of a healthy business environment and increased industrial activities.

A study by An *et al.* (2018) reveals that the whole world's production of the crude steel reached the cap of 1.63 billion tons in 2016 and the same year, consumption of steel rose at 1.52 billion globally. Liu *et al.* (2019) allude that the range of steel in the global market is so extensive that this variety allows catering to all market segments worldwide. According to Liu *et al.* (2019), steel produced in the US mostly consists of sheet metals such as plates, hot rolled coils and cold rolled coils and account for more than 70% of the total steel products. In contrast, in Europe, the steel market focusses on small section steels and hot-dip galvanised and the demand for these products has been rising in recent years. These steel products are made to cater for local and international markets. For instance, China is regarded as the world largest producer and exporter of steel (Gu *et al.*, 2019; Wang *et al.* 2019; Wu *et al.*, 2019), its steel production reached 808.4 million tons in 2016, accounting for 49.6 of the global output (An *et al*. 2018; Mehmanpazir *et al.* 2019; Zhang *et al*., 2019).

2.2.2.5 Information and Communication Technology (ICT) industry

The production of electrical and electronic equipment such as televisions, computers, washing machines, among others, forms part of people's daily life. As a result, the ICT industry has become the world's largest and fastest growing manufacturing sector in the twenty-first century (Gu *et al.*, 2016; Shareefdeen *et al.*, 2016; Singh *et al.*, 2017). Shareefdeen *et al.* (2016) highlight that in 2014, the value of the global electronics market was estimated at around $ 262 million, which figure was forecasted to increase by 13.8 per cent by the end of 2019. The fast development of the electronics industry is largely due to massive capital investments in research and development (R&D), which is an important factor to stimulate the economic development of a country through improved performance, efficiency and competitiveness (Bočková & Meluzín, 2016; Chandrashekar & Hillemane, 2017; Liu *et al.*, 2018). The authors further stress that evidence shows that the development of innovative activities results in higher sales and economic prosperity.

The advancement in technological development, as well as the sophistication of customers' needs and requirements, have led to the decrease of the intended lifespan of electronic devices, making them obsolete within the day of purchase (Ceballos & Dong, 2016; Gu *et al*., 2016). A classic example concerns the lifespan of computers, which went from 4.5 years in 1992 to 2 years in 2005 (Shareefdeen *et al.*, 2016). According to Bočková and Meluzín (2016), the ICT industry represents a supplying entity to other sectors such as automobile, aerospace, mechanical and engineering and plays a critical role in modern manufacturing. Global competitiveness has forced manufacturers to pursue the digitalisation of high-priority functions of their value chains and supply chains in general, as digital innovations are expected to help cut costs by 43 per cent and increase revenues by 35 per cent (Lu & Weng, 2018).

Based on these benefits and strategic roles that are played in the industries considered in the study, one can confidently argue that the manufacturing sector is at the centre of industrialisation of many economies as it provides job opportunities to active populations by absorbing a large pool of people and helps in eradicating poverty and socio-economic challenges. It is important to also emphasise that the manufacturing is a source of innovative technologies in modern economies and serves as the linkage between industries inside and outside (service activities) the manufacturing sector, hence promoting and providing the spill-over effects in the marketplace. Moreover, it becomes clear that a strong manufacturing sector is a hallmark indicator of a healthy, growing and prosperous economy. The primary goal for marketing strategies should be to add value to products and services through constant improvements and find paths towards sustainable economic development through the digitalisation of critical functions of the value and supply chains.

The next section outlines the South African manufacturing sector with a brief description of the institutional background in the Apartheid era and its implications in the quest for economic prosperity. It further discusses the period pre- and post-democracy, the leading manufacturing industries, the challenges they faced and their contribution to the South African manufacturing sector.

2.2.3 The South African manufacturing sector

This section discusses the South African manufacturing sector during the pre- and post-Apartheid periods, its developments, challenges and contributions to the economy of the country. It starts with the institutional background to provide an overview of the policies developed by the regime before democratisation.

2.2.3.1 Institutional background in the Apartheid era

During the Apartheid era, labour regulations were based on racial segregation. They were first developed and implemented in the mining sector and then later in the manufacturing sector (Mariotti, 2012; Lowenberg, 2014). The mining sector represented the largest contributor to the South African economy with a contribution amounting to 16 per cent to the GDP and employed a large pool of workers (Mariotti, 2012). It is further argued that the discriminatory policies were developed and adopted after the new Government was elected in 1924 with the aim of tacking the rising white unemployment rate, countering the dependency on imports to drive the mining sector and industrialising the country as a whole through the creation of state-owned enterprises (*Ibid*). During this attempt to reform the economy, several regulations and legislative pieces were developed to deepen societal divisions, which included: the Industrial Conciliation Act (ICA) adopted in 1924, which set out the determination of employment conditions for whites only and the exclusion of black people in labour negotiations (Maree, 2017): the Apprenticeship Act approved in 1944, which prohibited employers from skilling up black people through training and education (Mariotti, 2012; Brown et al., 2018): the Group Areas Act (GAA) passed in 1950, which pigeonholed black people in designated areas called homelands; and the Factories, Machinery and Building Work Act (FMBWA) passed in 1951, which required separate work facilities (bathrooms, restaurants, entrances, among others) between black and white workers; Furthermore, job reservation policies were implemented in all sectors of the economy and the manufacturing sector in particular and allowed whites who wished to work longer to keep their positions.

The reservation policy was developed to protect white workers from competing with blacks on the question of employment as it required the recruitment of black people in the manufacturing sector only when there was no white contender for the positions (Worku, 2015). It is important to also note that positions filled up by black people were mostly unskilled positions as skilled and semi-skilled jobs were reserved to whites (Mariotti, 2012; Mariotti & Fourie, 2014). The authors argue that the job reservation policy created a shortage of workers in the labour market, compelling manufacturing firms to invest in capital technology rather than in labour-intensive ones. Lowenberg (2014) argues that the Apartheid ideology was inherently flawed, selective, inefficient, costly as well as incompatible with the principle of allocation of resources and economic development. Moreover, it is argued that whites' unskilled workers benefited the most from the job reservation policy as firms in manufacturing were bound to employ high-priced white labourers (*Ibid*).

As a result of these restrictive policies as well as the racial ideology promoted and implemented by the Apartheid regime, the creation of a cohesive, inclusive and prosperous society became compromised, as widespread poverty, high unemployment and a low level of education remained elevated and greater in black communities. Furthermore, the legacy of Apartheid accrued in the low level of productivity and reduced the level of competitiveness since the participation of non-whites in the economy was limited. It is also necessary to recognise that the statutory job reservation system hindered the prospect of growth and economic development of South Africa and the manufacturing sector in particular.

2.2.3.2 Period of pre-democratic South Africa

During the dark history of South Africa, many historians believed that the purpose of developing the manufacturing sector was to create jobs essentially for poor whites at the expense of African people (Mariotti, 2012; Nattrass, 2014). Mariotti (2012) observes that the manufacturing sector was the largest in the South African economy that provided jobs essentially to white people. She argues that the mining sector employed at the time just ten per cent of whites and fewer of them were hired as labourers. African participation in the manufacturing sector was mostly limited to unskilled positions and a certain extent to semi-skilled jobs (Mariotti, 2012; Mariotti & Fourie, 2014).

The implementation of restrictive policies had slowed down the development of the South African manufacturing sector and consequently, it became exposed to over-investments into capital technology rather than labour-intensive investments (Todes & Turok, 2017). Lowenberg (2014) points out that even though Apartheid policies were costly to the economy, as key sectors, which include the manufacturing sector, could not run at their full potential, it is difficult to conclude with certainty that these policies were detrimental to the economic growth and prosperity of the country; since South Africa enjoyed a very high growth rate in 1948 and was on the international level only surpassed by Japan in the 1960s. The author further asserts that the economic growth rate would have been five to ten per cent higher than it was if the free labour market were instituted.

During the Apartheid era, the South African economy was already more modernised and diversified, based on agriculture, manufacturing and mining than the rest of Africa (Greffrath, 2016). This assertion demonstrates a mixed view of the outcomes of Apartheid policies on the economic growth of the country. However, an objective view of this matter will not condone the execution of practices on social and economic segregation to which black communities were subjected. The policies based on discriminatory ideologies did not help the country and the manufacturing sector to flourish at their full capacity as these controversial policies have somewhat undermined the productivity and efficiency of the manufacturing sector. Hence, they slowed down the economic growth and prosperity of South Africa.

It is observed that during the Apartheid era, the South Africa economy was highly characterised by protectionism, which resulted in inefficiency and lack of competitiveness in the manufacturing sector (Seekings & Nattrass, 2015; Wood & Bischoff, 2019). It is argued that the manufacturing sector was featured by unfair competitive practices supported by very active governmental policies that helped to fund local businesses and particularly Afrikaans owned businesses (*Ibid*). This view is also supported by Erten *et al.* (2019) who assert that South Africa was engaged in the legislation of import substitution industrialisation which shed South African organisations from the international competition through trade tariff hikes, duties and non-tariff barriers. Accordingly, as the manufacturing sector was considered the most relevant in the economy of South Africa, as it could absorb very large numbers of unskilled and semi-skilled individuals as well as drive the technological development, the Government was determined to protect its local businesses at all costs. It is important to mention that controversial policies of this kind are not inherently sustainable since they deprive manufacturing firms of engaging in crucial competitive practices through efficient use of resources.

The manufacturing sector and the South African economy as a whole was subjected to international isolation (Jain & Jain, 2017). The authors indicate that due to sanctions, the country could not trade internationally for valuable resources as vast numbers of countries cut diplomatic and commercial ties with South Africa. According to the authors, scientific and technological exchanges were boycotted, while foreign investments were moved from South Africa to other destinations. The authors view international sanctions as tools necessary to encourage and put pressure on the Apartheid regime to change its inhumane practices and build an inclusive South Africa based on international democratic values for all South Africans, regardless of their colour and promote justice, tolerance and diversity.

The next subsection discusses the end of Apartheid triggered by mounting international pressures as well as the rampant political, social and economic instability in the country. The purpose of these pressures was to force the leadership of the country to end the crime against humanity, create a just and equal society and promote citizenship for all.

2.2.3.3 Post-democratic South Africa

The end of Apartheid in 1994 coupled with the trade liberalisation of the South African economy which was followed by substantial tariff cuts as well as the ratification of trade agreements with the outside world (TIPS, 2016; Wood & Bischoff, 2019). Similarly, Nuruzzaman (2015) and Erten *et al.* (2019) point out that, in 1994, in the quest to open up the South African markets to the world economiess, gain from technological development and enjoy the benefits of globalisation, the South African Government made a tariff liberalisation offer to the General Agreement on Tariffs and Trade (GATT) in Uruguay and joined the World Trade Organisation (WTO). The motion was driven by the desire to foster foreign investments in key industries of the South African economy, which included the manufacturing sector and partner with international organisations to accelerate and build an inclusive society through sustainable industrialisation of the country.

Evidence suggests that trade openness, foreign direct investments, innovation, capital investments are critical success factors to promote and improve the sustainability and productivity of the manufacturing sector (Chikabwi *et al*., 2017). However, on the one hand, trade openness is likely to increase the demand for imported manufactured products by reducing their price. On the other hand, increased access to cheap products may lead to decreased production costs and increased profit of manufactured goods. It is valuable to dismantle tariff barriers aimed at promoting and guaranteeing the participation of South Africa in global trade and boosting its technological development while improving its economic conditions. As the legacy of apartheid resulted in widespread poverty, inequalities and mass exclusion of African people from economic activities as well as a high unemployment rate and a low level of productivity and competitiveness, the South African Government was determined to pave the way to the industrialisation of the country and integrate with the global economy (Department of Trade & Industry [DTI], 2019). Behun *et al.* (2018) assert that technological development and globalisation bring new kinds of product development and varieties of business models. In other words, any significant change in an industrial sector or economic sector as a result of technological advancement will trigger changes in the way all stakeholders interact, making it important to South

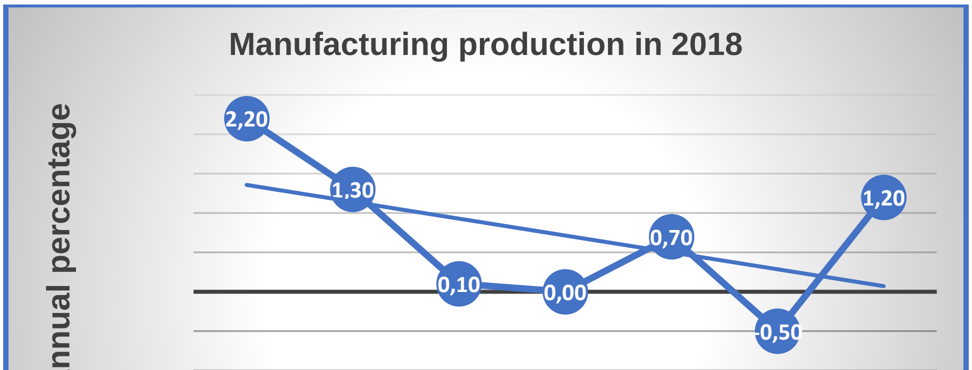
African manufacturers to constantly reinvent themselves to match the global technological development.

The current world is highly characterised by rapid changes in technological development sparked by the pace of industrialisation as well as the growth of global economies (Maheso *et al.*, 2018). The manufacturing sector plays a vital role in the economy of a country and manufacturers that wish to increase the level of competitiveness of their organisations need to benchmark their manufacturing practices and capabilities against the highly competitive global standards (Oyesola *et al.*, 2018). Tan *et al.* (2018) posit that manufacturing capabilities determine the level of competitiveness of manufacturing firms in global and local markets. The authors further advise that manufacturing firms need to adopt proactive strategies that will enable them to sustain the growth of their businesses and increase the effectiveness and efficiency of their resources.

Evidence suggests that the manufacturing forms the basis of many national economies, which is reflected through its high share of total output, employment opportunities and revenues and creation of sustainable economic development and growth (Herman, 2016; Behun *et al.*, 2018). Moreover, it is suggested that the manufacturing sector represents a high export output and pays relatively high wages as well as represents the main driver to create jobs in other areas, which include services and it is a key source of investments in research and development (*Ibid*). The average salaries and wages in the manufacturing sector in South Africa increased from R84 597 in 2008 to R225 499 in 2017, representing an annualised growth rate of 11,5 per cent (Stats SA, 2019). Furthermore, the South African manufacturing sector reported a total income of R2 599,4 billion in 2017, representing an increase of 7,2 per cent annualised over the income reported in 2014. In the same year, the manufacturing sector reported a profit margin of 5.5 per cent and the highest of 8.0 per cent in 2008. The manufacturing sector has seen a decrease in its production output since 2012 with a timid increase of 1.2 per cent compared to 2018 (see Figure 2.2). In addition, the South African manufacturing sector contributes around 14 per cent to the gross domestic product (GDP) and represents the country's fourth-largest sector (Mashiloane *et al.*, 2018; Stats SA, 2018).

Figure 2.3 portrays the repartition of various industries that constitute the economy of South Africa and their relative contribution to the GDP in 2018. South Africa Market Insights (2019) observes that despite the benefits that bring trade openness and foreign direct investments, the South African manufacturing sector is in decline since the end of apartheid in 1994. Its contribution to the GDP has been declining year on year and went from above 20 per cent in 1993 to below 14 per cent in 2016, as indicated in Figure 2.4.

Figure 2.2: South African Manufacturing production in 2018.

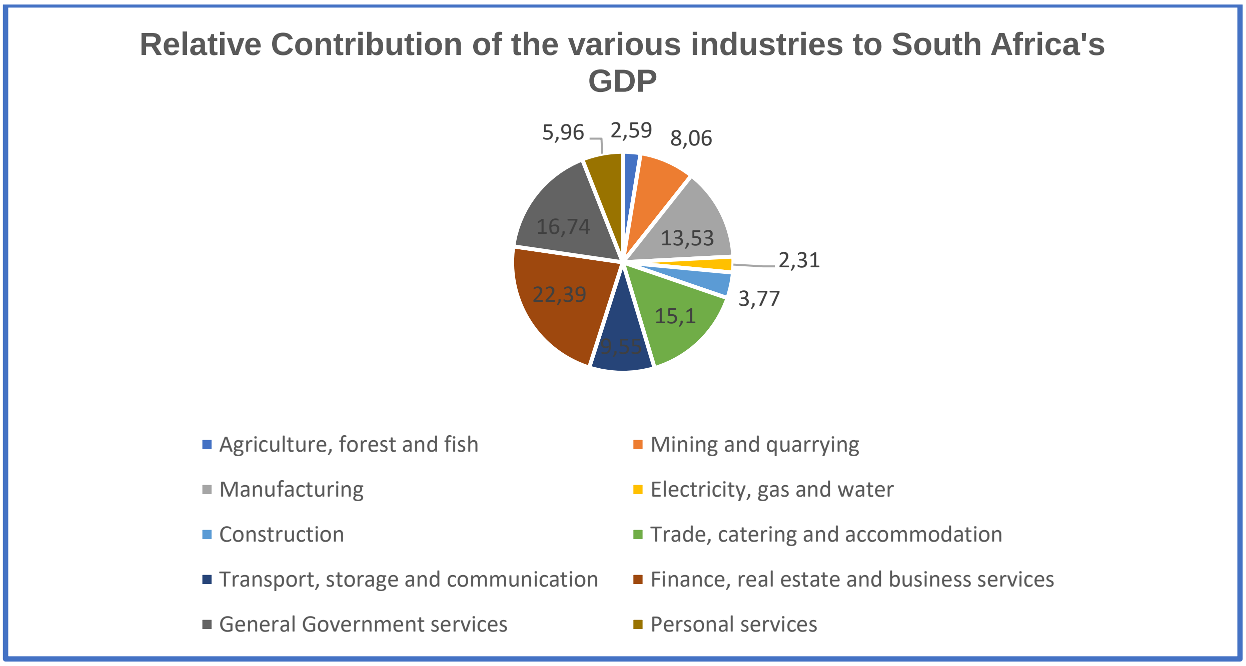


	2012	2013	2014	2015	2016	2017	2018
Series1	2,20	1,30	0,10	0,00	0,70	-0,50	1,20

Source: Statistics South Africa (2018).

The trendline of Figure 2.2 shows that the South African manufacturing output has been decreasing since 2012 with an improvement in 2018. This improvement follows a 0.5% contraction in 2017 which had come after a timid rise of 0.7% in 2016. This decline in productivity rate could be the result of the rising electricity cost and its unreliable supply because of persistent power blackouts which contribute to increase the overall energy cost making manufacturing companies less price competitive. Other possible causes may include the cost of labour, the mass retrenchment of employees, the lack of skilled workers and the inability of manufacturing companies to adopt proactive measures that can enable them to sustain their growth and increase the effectiveness and efficiency of their resources. This low rate of productivity may also indicate the need of the South African government and its business partners to intervene to support the struggling manufacturing sector.

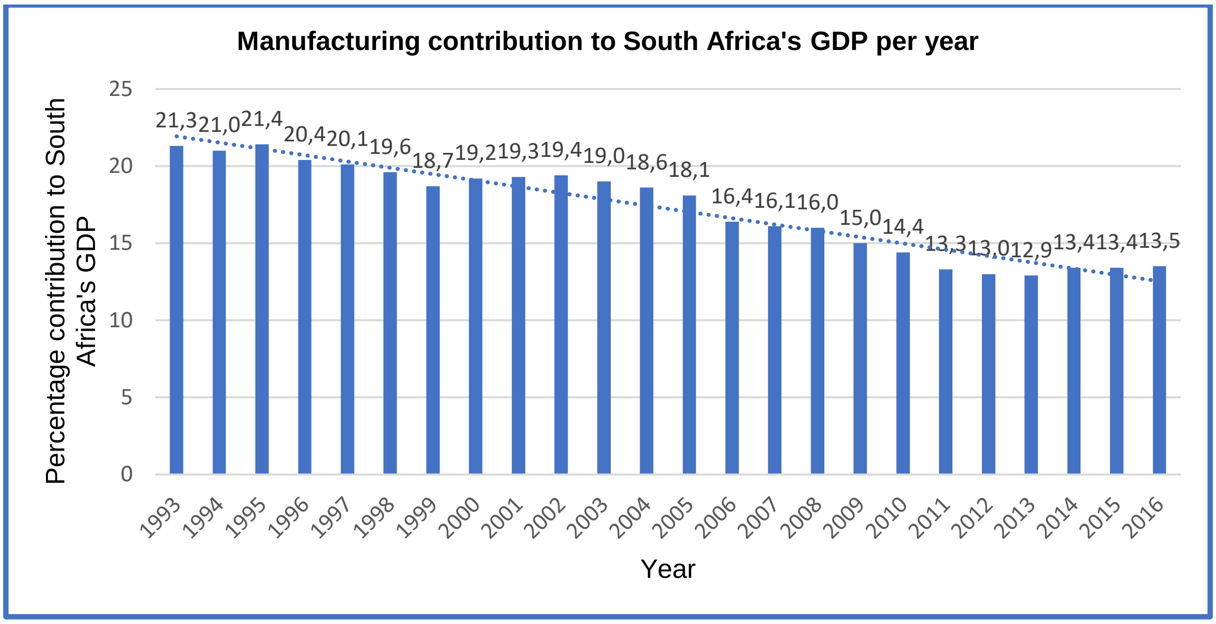
Figure 2.3: Relative Contribution of the various industries to South Africa's GDP



Source: Statistics South Africa (2018).

From the chart (Figure 2.3), it can be perceived that the finance, real estate and business services contribute the most to the GDP and that the manufacturing sector comes fourth. This shows the significant role the manufacturing sector can play in the growth and development of the South African economy.

Figure 2.4: Manufacturing contribution to South Africa's GDP per year



Source: South Africa Market Insights (2019).

The trendline in the bar chart in Figure 2.4 indicates that the contribution of the manufacturing sector to the GDP has been falling considerably over the years since the end of apartheid. Its contribution to the GDP fell from 21.3 percent in 1993 to 13.5 per cent in 2016 following the trade liberalisation policy that opened the South Africa market to international competition. This rate of decline should be very alarming to the South African Government and its people as the purpose of market liberalisation implemented in 1995 was to help refine, restructure the economic outlook of the country and boost its growth and sustainable development. The question that arises is, why is the manufacturing in decline since the end of apartheid? The section below discusses some possible causes that the researcher thinks have led to the decline of the South African manufacturing sector.

Studies by Hodge (2015) and Erten *et al.* (2019) found that reforms undertaken by the democratic Government of South Africa on apartheid labour legislations gave leverage to trade unions to negotiate higher wages and better working conditions for their members, resulting in an increase in labour costs, which in turn led to the decrease in the level of competitiveness and performance of the manufacturing sector. Moreover, Hodge (2015) explains that the rapid increase in domestic labour costs rather than abroad (international) prompted the decline of exported manufactured goods at the expense of imported manufactured goods as the costs of local production rose considerably. The reduction and removal of tariffs and duties as part of the trade liberalisation strategy has spurred to the increased demand for cheap imported goods and a weak level of employment (Erten *et al.,* 2019).

Moreover, the lack of dynamism and high unemployment are also factors that contribute to the slow growth of the South African manufacturing sector since the dawn of democracy (Edwards & Jenkins, 2015). The authors argue that the increased Chinese import penetration in South Africa has caused fierce competition to local producers and significantly impacted the manufacturing sector in general as well as sparked the rise of unemployment across many sectors of the economy. Moreover, the authors point out that China has become the largest South African export market for manufactured goods ready for consumption. In contrast, South African exports to China are overwhelmingly limited to processed raw materials, resulting in trade imbalance. Mashiloane *et al.* (2018) and South Africa Market Insights (2019) affirm that the performance of the South African manufacturing sector is affected by external factors, which are related to the global competitiveness, the weakening of the local currency, the volatility of the global economy, the shortage of critical skills and a host of political, social, technological as well as ecological factors.

Adding to the view above, the United Nations (2019) reports that the decline in economic conditions of South Africa is affected by currency depreciation and equity markets. The organisation further stresses that the deterioration in investor perception or confidence is reflected by a weak growth outlook and persistent macroeconomic imbalances, exacerbated by high political uncertainty. For these reasons, Behun *et al.* (2018) argue the manufacturing sector is a cyclical sector in its essence as it is affected by market volatility, currency fluctuations among others as a result of variations in the global economic cycle. Evidence also shows that FDI in South Africa has been very volatile due to their sensitivity to commodity price changes. Under these circumstances, it is important to note that FDI inflows in South Africa have declined by 20 per cent between 2001 (US$ 7.3 billion) and 2002 (US$ 1.5 billion) due to significant depreciation of the South African Rand against the US dollar, causing investment risks to rise and capital flights to flourish and intensify (Sunde, 2017).

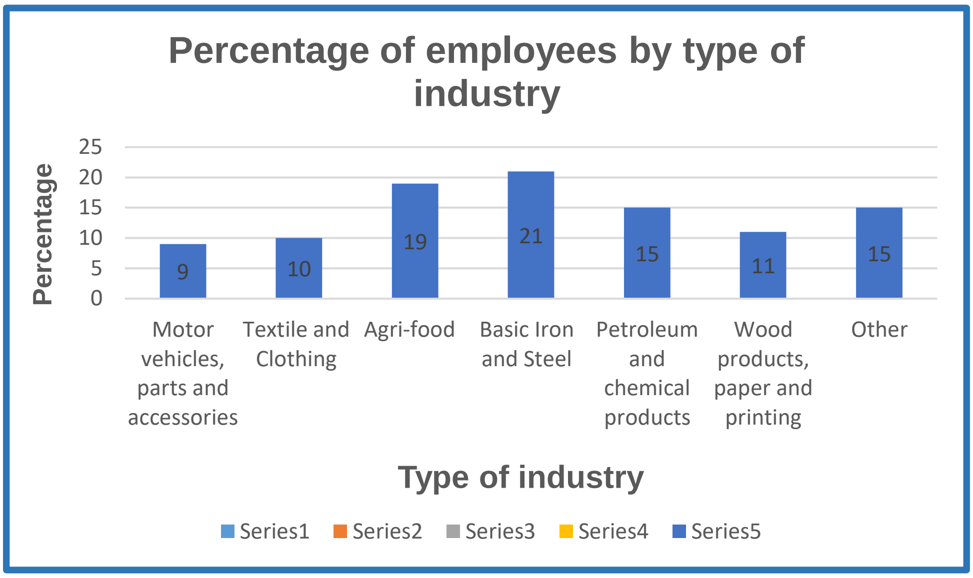
As far as employability is concerned, according to Statistics South Africa (2019), the total number of persons employed in the manufacturing sector as at the end of June

2017 was 1 180 274. The employment in the manufacturing sector declined from a high of 1 344 170 in 2008 to a low of 1 1720 568 in 2014 (a loss of 171 602 jobs). These figures indicate that in a pleasant business environment or business conditions free from continuous socio-economic imbalances and political crisis, the manufacturing will create jobs for people, especially in the context of the South African rising demography. Mashiloane *et al.* (2018) stress that the manufacturing sector is one of the most notable drivers of economic development through the absorption of unskilled and semi-skilled workers. Moreover, Oguntoye and Evans (2017) suggest that the manufacturing sector can offer an excellent opportunity to develop skills and advance technological development as well as serve as an incentive for infrastructural development. Reliable infrastructure is an essential ingredient that facilitates, promotes and fosters the development of the manufacturing sector as well as other priority sectors of the economy (Mehta & Rajan, 2017). Pheko *et al.* (2017) affirm that the South African manufacturing sector is an important component of the economy that drives sustainable growth and possesses the highest growth factor and employment multipliers than all other sectors of the economy. The next section discusses five industries within the South African manufacturing sector that the author has chosen because of the significant importance they carry in the development of the macroeconomy of the country.

2.2.4 Major industries in the South African manufacturing sector

The South African manufacturing sector comprises ten industries of which five under consideration in the study are discussed in the sections below, namely the automotive industry, metal industry, textile, clothing and footwear industry, agri-food industry and chemicals industry. These industries were selected partly at the discretion of the researcher and because of their ability to provide jobs to large number of individuals, hence reducing the unemployment rate, fostering the socioeconomic development, and driving up the manufacturing output. Figures 2.5 and 2.6 portray the data that motivated the selection of these industries.

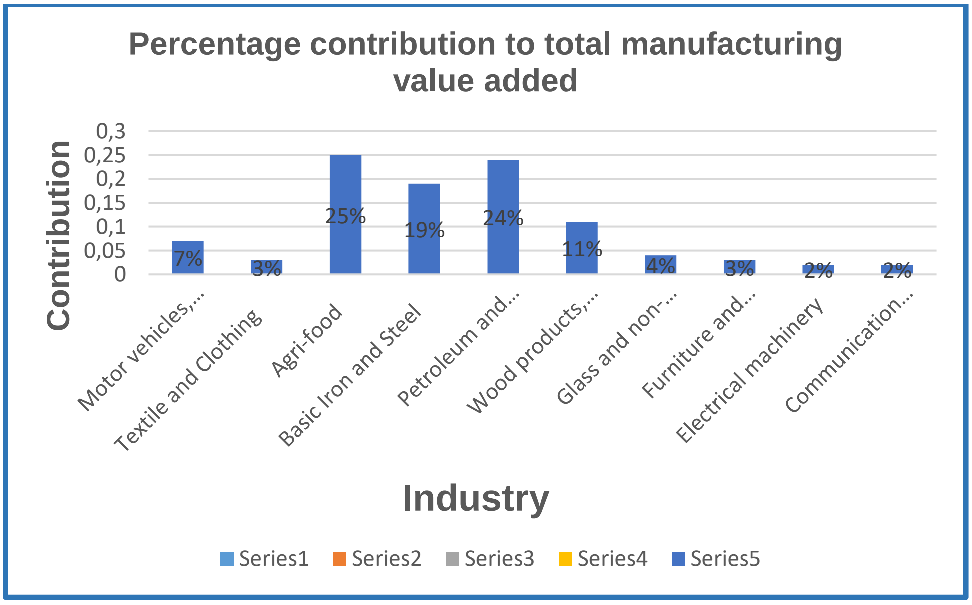
Figure 2.5: The largest employers



Source: Statistics SA, (2018).

Figure 2.5 shows that the basic iron and steel industry employs the largest number of individuals in the manufacturing sector (21%) followed by the Agri-food (food and beverages) and petroleum and chemicals industry (19%). The textile clothing industry (10%) and motor vehicles (10%) make the top six.

Figure 2.6: Contribution to the total manufacturing



Source: Statistics SA, (2018).

Figure 2.6 shows that the Agri-food industry (food and beverages) is the most important player in the manufacturing sector, contributing 25% to the total manufacturing followed by the chemical (24%), basic iron and steel (19%) and wood products (11%).

These data show the role played by the selected industries in strengthening the economic growth of South Africa.

2.2.4.1 Automotive industry (Motor vehicles, parts and accessories)

Evidence suggests that the automotive industry is one of the largest and fastest-growing industries in the manufacturing sector as well as one of the most important components to drive economic and social growth (Komarasamy & Hoque, 2015; Brönner *et al*., 2019; Nazir & Shavarebi, 2019). Moreover, Pheko *et al.* (2017) affirm that the automotive industry is considered as the main contributor to the productivity of the manufacturing sector in South Africa and represents the most dynamic industry because of its ability to produce large numbers of vehicles, wide varieties of brands meeting high international standards. The importance of this industry is crystallised in the South African's National Industrial Policy Framework as well as in the Industrial Policy Action Plan (South African Government, 2018). Additionally, the automotive industry accounts for 6.9 per cent of the South African's GDP and employs 110 000 persons in vehicles and component's production and invests R12.2 bn annually (South African Government [SAG], 2018; Department of Trade Industry [DTI] 2019).

South Africa is recognised as the powerhouse of the African automotive industry, producing in 2018 more than half of the total vehicle's output on the continent (Mund *et al.*, 2015; SAG 2018; DTI 2019). It is important to stress that the capacity of the South African automotive industry to produce vehicles of high-quality standards has afforded the country the opportunity to be the chosen as the destination of eight major auto manufacturers and multiple component suppliers (Deloitte 2019). In addition, SAG (2018) and DTI (2019) report that automotive exports are valued at almost R180 bn and represent 14.3 percent of South African exports. Deloitte (2019) and The Mail and Guardian (2019) report that the South African Government has recognised the vital role that plays the automotive industry in the economic and social development of the country and as a result, has established and implemented incentive programmes that would help to shape the economic outlook of the country and support local automakers. Consequently, the latest automotive policy, the South African Automotive Masterplan (SAAM), aims at widening and deepening local value chains, driving the economic development as well as supporting research and development, innovation and productivity through social and economic inclusion (Deloitte, 2019; DTI 2019).

2.2.4.2 Basic iron and steel industry

The iron and steel industry has fundamentally transformed the modern world and represents one of the major drivers of economic development and job creation (Cronjé, 2016; Nielsen, 2018). Cronjé (2016) stresses that the iron and steel industry in South Africa employed more than ten thousand people on a full-time basis in 2016 and affected the lives of more than hundred thousand contractors and employees in its downstream supply chain operations. According to He and Wang (2016) and Nielsen (2018), the steel industry plays a key role in products supplied to various industries, such as automotive, construction, transport, power and machinery industries, making it an essential component for creating business and job opportunities for millions of people as well as new markets and demands. Dondofema *et al.* (2017) indicate that the iron and steel industry has been crucial for economic development and the path towards the industrialisation of South Africa. These authors further stress that the industry has not been performing at the pace it was expected to since increased competition from international players in the steel market resulting in job losses and decline of iron and steel productivity since 2005. Furthermore, Meintjes (2019) stresses that there has a been a decline of one-third in steel production in almost a decade due to lack of adequate resources to enhance productivity as well as the increase in imported steel products from Asian countries.

Despite the strides made by the Government to protect local steel producers and preserve jobs for millions of South African through tariff hikes and duties on imported steel products (ten per cent) since the end of 2015, the iron and steel industry remains very vulnerable to market volatility and to international competition, as local producers do not possess the technologies and skills required to improve the efficiency and effectiveness of steel production (Cronjé, 2016; Meintjes, 2019). Furthermore, Nielsen (2018) argues that the existence of obsolete technologies is detrimental to the effective and efficient use of resources and continuous economic growth. According to the author, firms that need to remain competitive and maintain market-dominant should embrace technological advancements aimed at lowering operating costs while improving productivity. Chitaka *et al.* (2018) argue that the vulnerability of the South

African iron and steel industry is the result of the decline of the global steel demand, the decrease in steel prices as well as the geographical shift in trade dynamics. The authors view these factors as urgent threats to the survival of the domestic iron and steel market.

2.2.4.3 Textiles, clothing and footwear industry

The South African textile, clothing and footwear industry play a central role in the economic development and the lives of people as clothes represent one of the basic requirements of all human beings (Van Zyl & Matswalela, 2016; Matsoma & Ambe, 2017; Matsoma, 2018). The clothing industry in South Africa comprises three main stakeholders that drive industry development, namely fabric suppliers, fashion designers and clothing manufacturing, each having a unique role and character in the production line (Matsoma & Ambe, 2017). Matsoma (2018) indicates that this industry contributed up to 14 per cent of the total output of the manufacturing sector in 2013, making it a significant contributor to the South African GDP. The South African textile and clothing industry represents the sixth largest manufacturing employer and the eleventh largest manufactured good exporter (Sheldon *et al.*, 2018). Furthermore, Filho *et al.* (2019) stress that the industry is of great importance to many countries around the globe in terms of employment opportunities, wealth creation, trade, investments and revenue generation.

Evidence suggests that more often, the textile industry's supply chain is considered as an essential catalyst to create employment opportunities for small and family businesses as well as unskilled labour (Filho *et al.*, 2019). Matsoma (2018) affirms that the South African textile industry forms part of small and medium enterprises as Cut-Make and Trim (CMT) firms constitute about 80 per cent of the textile and clothing industry. According to the author, CMT manufacturers provide a wide range of services by cutting, making and trimming garments as per customer requirements. Van Zyl and Matswalela (2016) and Worku (2019) argue that since the trade liberalisation, the textile industry in South Africa faces fierce competition from Asian countries and China, in particular, resulting in a decrease of exports and increase in imported products. The authors perceive that the decrease in exports is due to the high-cost structure that does not enable South African textile manufacturers to compete effectively and efficiently with low-cost products from Asian countries, thereby exacerbating job losses and business closure (Matsoma & Ambe, 2017), consequently leading to the decline of clothing manufacturers.

Moreover, Worku (2019) stresses that Chinese footwear and garments have flooded the South African textile market at the expense of local producers and their imports to South Africa account to 74 per cent, which shows the competitive advantage that China has in world textiles and South Africa in particular. Makasi and Govender (2015) state that globalisation and trade openness have created knock-on effects on emerging countries such as South Africa, leading to complexities in the marketing landscape. They further indicate that any lack of effective policies to absorb domestic and external shocks will only condemn organisations to underperform. In line with this assertion, one can argue that South Africans manufacturers as well as the Government did not react faster, effectively and efficiently to changes in the textile and clothing market to curb the consequences brought about by trade liberalisation. To effectively compete with international organisations, local manufacturers need to pursue new business models, develop new capabilities that will create and exploit complementarities of the global supply chain operations.

2.2.4.4 Agri-food industry (food and beverage)

The food and beverage industry represents the most substantial subset of the manufacturing sector, accounting for 26 per cent of the total manufacturing outputs and employing 20 per cent (236 515 people) of the full employment in this sector (Musvoto *et al.*, 2015; The South African Market Insights, 2019). These figures portray the crucial role played by the industry in generating jobs, helping to eradicate poverty and contributing to creating an equal society as well as promoting the economic prosperity of the country. Kabasa *et al.* (2015) and Minde *et al.* (2015) argue that by 2025, the agri-food system will expand and increase while generating one-third of jobs on the African continent as a result of food marketing, processing and distribution. It is crucial to indicate that the expansion and growth translated through the increased market share of the food and beverage industry is partly due to the rise of urbanisation coupled with the growing middle-class income that have increasingly shifted the consumption of traditional diet to a more westernised diet, based on processed foods, packaged convenience foods and prepared foods (Kabasa *et al.*, 2015; Kaneene *et al.*, 2015; Marais *et al.*, 2019). The spatial shift towards urban areas will continue to widen food markets and their productions as well as processed foods and their auxiliaries (Kaneene *et al.*, 2015).

It is observed that the key characteristic of the beverage and food industry is its ability to create linkages between up and down streams of their supply chains (Musvoto *et al.*, 2015); The International Trade Administration Commission of South Africa [ITAC] 2016). Upstream, the sector is linked to primary agriculture, whereas downstream of the supply chain the sector is linked to agro-processing outputs, both intermediary and final products. Furthermore, ITAC (2016) indicates that the food division of this industry remains the more dominant component, accounting for 78.8 per cent of the total outputs and generating 73.4 per cent of employment while the beverages division represents only 21.2 per cent of the total outputs and creating 26.6 per cent employment during 2012-2014.

Given the importance that the food and beverages industry plays, as well as pressures from the South African health department through stringent regulations, South African manufacturers, have made significant investments to boost the research and development in their sector to improve public health while creating wealth. Advances made in technological development consist of maintaining and upgrading all existing facilities and building new plants to increase the production's capacity, delivering quality and safe products to consumers and improving the overall efficiency of their processes (Ronquest-Ross *et al.*, 2018). Ronquest-Ross *et al*. (2018) further suggest that the South African food and beverage industry is keeping pace with global technological advancements in terms of automation, process control and quality, food safety practices and the entire supply chain management as five of the top ten food manufacturing companies in South Africa are proudly South African.

2.2.4.5 Chemicals industry (petroleum and chemical products)

The chemicals industry in South Africa is recognised as one of the most important drivers to accelerate economic development and growth and to support the path towards industrialisation (Burger, 2019). The industry is believed to be very sophisticated and represents the largest of its kind on the African continent. It accounts for 25 per cent of the manufacturing sector and five (5) percent of South Africa's GDP (Oliveira, 2014; Brand South Africa, 2017; KPMG, 2019). Oliveira (2014) points out that the growth of the chemical industry is mostly driven by the automotive industry, mining industry, construction industry and paints and coatings end-users. Burger (2019) posits that the industry possesses twelve-times multiplier effects for creating jobs and a 5.5 times multiplier factor on the GDP’s contribution in the country. For example, in the United States of America, it is estimated that each chemical firm job generates about 7.5 jobs elsewhere in the economy, which is a demonstration of the linkage role that the chemical industry plays with other industries in creating employment for the population (Penfold, 2015).

In addition, in 2017, the South African chemistry industry contributed to 15.3 per cent of the total employment in the manufacturing sector, making it one of the crucial components for the economic development (The South African Market Insights, 2019). Brand South Africa (2017) reports that the chemicals industry is very complex and highly diversified with final products often being composed of a number of chemicals which have been combined in some way to provide the required properties and characteristics. Oliveira (2014) argues that the South African chemical industry is faced by challenges stemming from the importation of raw materials which is subjected to exchange rates and poor conditions of its technologies and processes used to produce chemical products. To tackle these challenges, KPMG (2019) suggests that chemical companies should find innovative ways to drive operational excellence, undertake successful paths in times of uncertainty and develop products that match the emerging global trends, such as population growth, water and food scarcity, sustainability, including energy use and climate change. The next section discusses the legislative framework for the South African manufacturing sector that contributes in shaping, defining and developing the economic outlook of the country.

2.3 LEGISLATIVE FRAMEWORK FOR THE MANUFACTURING SECTOR

Government policies are important frameworks that contribute to shaping and defining the economic development of any country. If policies are implemented in an effective manner, they will help create and build national sustainable development across all sectors of the economy (Okolo, 2018; Enaifoghe, 2019). Chikabwi *et al.* (2017) report that small investments in manufacturing are not enough to drive and sustain their productivity and economic growth. The authors argue that policies are needed as they play a meaningful role in shaping socio-economic development and carry the highest weight to promote research and development, develop funding incentives, foster patent protection as well as private research and design activities.

The growth in isolation is not enough to build a sustainable economy and meet the need of the population. What is needed to sustain growth is an inclusive and diverse structure or system that will create job opportunities for all (Sunde, 2017). Since the end of apartheid in 1994, South Africa is striving to rebuild and transform its economy, devastated by years of isolation and international sanctions. South Africa witnessed the creation of many programmes, which comprise the National Development Programme (NDP), the Growth Employment and Redistribution (GEAR) programme and the Accelerated and Shared Growth Initiative for South Africa (ASGISA). These policies had the role of reducing poverty, fight crime and social and economic imbalances and fostering and accelerating the economic sustainability of the country (Sunde, 2017; Enaifoghe, 2019).

In 2003, in search of strategies to empower previously disadvantaged citizens, the South African Government introduced the Broad-Based Black Economic Empowerment (BBBEE) Act to transform its economy and promote skill development programmes of black people while supporting black-owned businesses (Mersham & Skinner, 2016; Makka & Nieuwenhuizen, 2017). The authors emphasise that the BBBEE Act was adopted and implemented to restore the social and economic imbalances that gripped the country during apartheid. The Act, according to the authors, would cement the participation of black people into the mainstream economy and build capacities in the manufacturing sector for national sustainable development. Similarly, in 2014, the South African Government launched the Employment Tax Incentive programme to stimulate the demand for youth labour, which requires firms to hire individuals between 18 and 29 years (Amina *et al.*, 2017).

A study by Wentzel and De Hart (2015) indicates that, in 2011, the South African Government, in its quest to promote industrialisation across the country, identified six industrial sectors, which included the manufacturing sector that it believes will help reduce the high rate of unemployment and foster economic growth. Its industrial policies have a strong emphasis on the manufacturing sector as a result of its strong spill-over effects and productivity. Currently, the unemployment rate of South Africa for the third quarter of 2019 lies at 29.1 per cent (Stats SA, 2019). With this high rate of unemployment, the primary policy focus of the South African Government should be to create millions of jobs and eradicate poverty (Amina *et al*., 2017). To facilitate the economic expansion and growth of the country, the South African Government has introduced various incentive programmes for local and foreign investments, such as the Industrial Policy Projects (IPP), Automotive and Development Programmes (ADP) and Enterprise Development Programme [EDP] (Wentzel & De Hart, 2015; Enaifoghe, 2019). The purpose of these incentives, on the one hand, is to attract investors in the country, particularly in the manufacturing sector and on the other hand, to minimise divestments.

Evidence suggests that foreign investments and trade openness, among others, play a critical role in the technological development of the manufacturing sector. Hence, it is imperative that the South African Government policies address these factors (Chikabwi *et al.*, 2017). Sunde (2017) posits that foreign direct investment policies represented a source of funding in South African businesses and a means of improving the foreign currency reserves. Sunde (2017) further indicates that since the end of apartheid, FDI mostly emphasised creating jobs in the manufacturing sector by developing investment incentives since South Africa is highly labour intensive. Initiative programmes such as the Motor Industry Development Program (MIDP) and Strategic Investment Program (SIP) were instituted to help increase FDI in the manufacturing sector, enhance economic growth by facilitating global positioning and competitiveness (Barnes *et al.*, 2018).

Despite the effort by the South African Government to promote the development of its manufacturing sector, the cost of doing business in South Africa is enormous as the environment is characterised by a high level of crime, a low rate of skilled workers and highly fluctuating exchange rate. The South African Government needs to develop robust measures that can accelerate inclusive and sustainable industrialisation of all sectors of its economy, hence achieving a sustainable development.

2.4 CONTRIBUTION OF THE MANUFACTURING SECTOR

The manufacturing sector represents an important pillar to stimulate the development of any given economy. In South Africa, the sector offers the highest potential to promote innovation, reduce widespread poverty, advance growth in other sectors of the economy such as services, create jobs for the working class and foster economic empowerment (Macpherson, 2019). This section discusses economic, social and political factors that can contribute to the development and meaningful growth of the South African manufacturing sector.

2.4.1 The economic contribution of the manufacturing sector

The advent of democracy in South Africa coincides with the structural output shifts towards the revival of other sectors of the South African economy, particularly the manufacturing sector to limit the reliance only on mining and agriculture to develop and grow (Brand South Africa, 2017). The diversification of the manufacturing sector, according to Brand South Africa (2017), offers a platform of growth opportunities for organisations of all sizes to help the foster economic development of the country. Evidence suggests that sustainable economic growth in the modern economy is a result of industrialisation, mainly manufacturing production (Afeikhena & Olu, 2019). Industrialisation through the electricity supply is perceived at a key driver of business opportunities and a better life for the population (Essex & De Groot, 2019). Afeikhena and Olu (2019) argue that, for the past few decades, the rapid growth in manufacturing has stimulated the increase in employment as well as the upsurge of productivity as a result of improved efficiency, allowing manufacturers to compete in the global markets successfully.

Similarly, technological advancements in the manufacturing sector and their spill-over effects have triggered the development of services and other industrial sectors in conjunction with the overall economic outlook. Oyesolaa *et al.* (2018) stress that advanced manufacturing techniques contribute towards the global competitiveness of the manufacturing sector. The South African manufacturing sector accounts for 14 per cent of the GDP and represents the country's fourth-largest sector (Mashiloane *et al*., 2018; Stats SA, 2018). Macpherson (2019) stresses that, for every rand invested in the manufacturing sector, the South African fiscus gains 35 cents and R1.13 of output is generated. The author reports there has been a decrease in productivity due to rising wages as well as prices for electricity.

2.4.2 The social contribution of the manufacturing sector

The rapid pace of technological development in the manufacturing sector and global economies has triggered the need of highly trained human resources to enable firms to efficiently and effectively deal with global competitiveness since the survival of manufacturing firms is dependent on the ability of the working class to discharge their duties to satisfy, meet or surpass the requirements of the consumers through production technologies (Maheso *et al*., 2018). Evidence suggests that the technological expansion is becoming the hotspot for manufacturing for the fourth industrial revolution to support various needs of the population and be used as a competitive tool to outperform business rivals (Oyesola *et al.*, 2018; Van Rensburg *et al.*, 2019). Technological innovation and development bring significant social benefits such as the creation of employment, social entrepreneurship and skill development, particularly of youth, that help eradicate poverty and fight crime, which factors constitute vital issues to the development of South Africa (Van Rensburg *et al.*, 2019).

A study by Magombeyi and Odhiambo (2018) found other venues of socio-economic developments by arguing that direct foreign investments in South Africa created hundreds of jobs and significantly reduced poverty through economic development of the working class. Similarly, Afeikhena and Ajakaiye (2019) suggest that the manufacturing sector is a relevant component for generating rapid job growth for low and semi-skilled workers, which includes women and youth (Afeikhena & Ajakaiye, 2019). Afeikhena and Ajakaiye (2019) further assert that the importance of the manufacturing sector is significant and comes in the context of the rising demography of the African continent where over 450 million new workers, main youths, are expected to take part in labour markets by 2035. Van Rensburg *et al.*, (2019) stress that one in three youths in South Africa is unemployed despite the role that the youth can play in supporting inclusive and sustainable economic growth and development. Likewise, Staista (2020) reports that in 2019, the youth unemployment rate was standing at 53.18 per cent, which is detrimental to social growth and prosperity. Macpherson (2019) also argues that the manufacturing sector has the highest job multiplier factor than any other sector of the South African economy as for every R1 invested, three jobs are created. The statistics provided can be used as a driving force or motive to promote sustainable development of the manufacturing sector and reduce unemployment and inequalities across the country.

2.4.3 Political contribution of the manufacturing sector

Having recognised the challenges, which include the high level of unemployment, deepening poverty and inequalities faced by South Africa, the Government published the Nation Development Plan (NDP), which aims at providing steps to implement towards achieving sustainable development (Klausbruckner *et al.*, 2015). Bhorat and Rooney (2017) and Macpherson (2018) suggest that manufacturing is a catalyst of economic growth and development, which can effectively address the challenges faced by South Africa through absorption of large pools of workers, as the sector possesses the highest job multiplier factor. An excellent political climate, stable social and sectoral performance and a high level of business confidence are essential ingredients for sustainable development of the manufacturing sector and South Africa in general (Shoba 2018). These features send a positive signal to the international audience by presenting the host country as a basket of business opportunities with prospects of economic growth and prosperity.

The efforts to boost the economic growth of the country have been witnessed through the desire and hunger of President Cyril Ramaphosa to significantly improve the climate of business and policies, cut the unemployment rate and fight the rampant public corruption activities to restore macroeconomic stability of the country and avoid a downgrade by credit-rating agencies (Nordea Trade, 2020; Santander trade, 2020). The United Nations Industrial Development Organization [UNIDO] (2017) reads that the improvement in industrial policy certainty is essential for sustainable development as it helps to enhance diversification, promotes economic transformation, fight poverty, improve income distribution and increase the size of domestic markets for manufactured goods.

Similarly, Ghebrihiwet (2018) indicates that policy certainty allows foreign companies to collaborate, purchase products, make investments in local suppliers, hire and train local workers and stimulate technology and knowledge transfers to local firms to develop them (Ghebrihiwet, 2018). For example, local content policies under implementation by the South African Government require foreign organisations to purchase a certain percentage of goods used in their production processes to local producers. Such a programme empowers domestic suppliers and manufacturers and spurs their economic emergence. Ghebrihiwet (2018) argues that the labour and technological spillovers may enable local workers to fill highly skilled positions in locally established firms as well as contribute to enhance the productivity and strengthen the supply chain of local manufacturers. UNIDO (2017) reports that technology transfer allows for the extension of existing industries and the realisation of the economy of scale, hence increasing productivity and lowering costs, enables producers to reach their organisational goals.

Based on the above, the Government needs to restore confidence to business communities, render stable the political, economic and social landscape through policy certainty and fight corruption activities. It also needs to focus on manufacturing since the sector has the potential to create jobs and reduce the high rate of unemployed persons. These efforts can help eradicate poverty, fight rampant crime and reduce unemployment in South Africa. The policies of the country should emphasise investing in manufacturing through research and development, new technologies to drive down the cost of production and make the sector profitable and attractive to potential investors. Finally, the implementation of incentive programmes should be enforced to increase the appetite of investors, provide job opportunities, develop skills and promote corporate social responsibility which is beneficial to the population.

2.5 CHALLENGES FACING THE MANUFACTURING SECTOR IN SOUTH AFRICA

The geographic frontiers in this twenty-first century are becoming more and more blurred since the world economies relentless try to create a single market as a result of globalisation (Salahuddin *et al.*, 2019). This economic rapprochement and quest for new business opportunities continue to pose severe challenges to local manufacturers as well as local governments. This section discusses the economic, social, environmental, legislative and political challenges faced by the South African manufacturing sector.

2.5.1 Economic challenges

The quest to clinch multilateral trade agreements with the outside world as well as the desire to open South African markets to international players have resulted in severe and rough competition in domestic markets (Katombe & Munapo, 2016; Wood & Bischoff, 2019). Wood and Bischoff (2019) argue that fierce and intense competition can be perceived through the increased threat of imported manufactured goods across South Africa. The increase of imported products has resulted in less demand from the labour force and triggered the closure of many South African manufacturing firms which could not compete with low-cost products from abroad (Wood & Bischoff, 2019). South African Market Insights (2019) reports that it is well established that South Africa imports more and more final manufactured goods from Asian countries, which in turn has led to reduced demand for locally produced goods.

It is reported that strike activities in South Africa and the issues of energy supply in manufacturing, mining and agriculture have also contributed to the sluggish economic growth of the country in 2019 (The International Monetary Fund [IMF], 2019). Furthermore, the IMF (2019) highlights that business confidence has been declining as a result of political instability, which is impacting the economic outlook of the country. Most recently, the increased tension between the United States of America (USA) and Iran, the Brexit referendum and the trade war between the USA and China have heightened economic uncertainty and market volatility around the world and in South Africa in particular (Binge & Boshoff, 2019). Binge and Boshoff (2019) further stress that during the period of uncertainty, investments and recruitments are put on hold until the future unfolds, which leads to the decline in economic activities across the country. Manufacturing production has been adversely affected recently in South Africa by frequent load shedding, higher input prices, fuel increase and weak domestic demand (Macpherson, 2018). In addition, the demand for manufactured exports has weakened as global manufacturing production slowed amid ongoing international trade tensions and the drop of business confidence among manufacturers (South African Market Insights, 2019).

The loadshedding or blackout occurrences within the South African business environment are now becoming a predictable future, which cripples the prospect of growth and economic development of the country as well as its capacity to achieve industrial objectives set by the Government (Ateba *et al.*, 2019). Ateba *et al.* (2019) further allude that the industrial decline and the sluggish economy landscape have a direct correlation with decreasing sustainability of the electricity supply. The manufacturing sector consumes a large amount of energy (electricity and water) and to develop will require a consistent and reliable source of public utilities, good infrastructure and better logistics (Mjimba, 2016; LI, 2017). Li (2017) further argues that the dire conditions of the manufacturing significantly contribute to increasing the cost of investments, which is a factor of deterrence of potential investors.

Moreover, South African manufacturers are faced with issues related to the rising costs of energy, material and increasing wages, which make products of local manufacturers expensive for consumers to buy since these factors increase the production costs (Katombe & Munapo, 2016). For instance, from 2007 to 2017, Eskom tariffs have increased by 300 percent against inflation, making it very expensive for local and foreign investors to engage in business activities (Macpherson, 2018). Katombe and Munapo (2016) further identify three main challenges that represent a stumbling block for the manufacturing sector, namely the operational costs, the process operations variability and competition from low-cost sources.

2.5.2 Social challenges

The way policies are implemented influences the socioeconomic conditions of a country (Cassim, 2018). Evidence suggests that a high level of unemployment characterises South Africa, high rate of crime, rampant public sector corruption and shortage of skilled personnel, all of which hamper the prospect of the developmental paths undertaken by the country to reach social justice and prosperity (Cassim, 2018; Makka & Nieuwenhuizen, 2018). Nordea Trade (2020) reports that there was a slight increase in South Africa's unemployment rate in 2018; from 27.5 per cent in 2017 to 27.9 percent in 2018. Additionally, the unemployment rate is much higher among youth and the black majority of South Africans, which further increases inequalities in the country and makes South Africa one of the most unequal societies in the world, where a smaller part of the population still lives on one Euro per day (Nordea Trade, 2020). Statista (2018) reports that in 2018, the youth unemployment rate lay at 52.85 per cent while the overall unemployment rate for the third quarter of 2019 was at 29.1 percent (Statistics South Africa, 2019).

The discriminatory policies of the apartheid era have significantly and negatively impacted on the availability as well as the quality of education for disadvantaged population groups, exacerbating the issue of unemployment and shortage of skills (Le Roux, 2018). Le Roux (2018) further posits that embracing technological innovation and development has the potential to create long-term structural unemployment system by devaluating low-skilled labour, hence it is necessary to invest in education and skills development. Le Roux (2018) perceives that skills which enjoy demand are more advanced and technically oriented, which is not the case of a large working-class population in South Africa.

Collective bargaining unions represent an undeniable challenge to South African labour markets as wages are perceived by manufacturers to be too high to clear the market demand (Ebrahim *et al.*, 2017). Higher wage demands allow manufacturers to discriminate against less experienced young workers, hence increasing the unemployment rate (Ebrahim *et al.*, 2017). Makka and Nieuwenhuizen (2018) express great concern about the youth's high unemployment rate, increasing level of poverty and deepening inequality since these challenges constitute an absolute obstacle to the socio-economic development of the country, particularly in manufacturing. Maheso *et al.* (2018) emphasise that the South African education system is of poor quality as higher institutions are unable to produce competent engineers who meet the requirements of the dynamic manufacturing environment. The authors perceive that the gap constitutes a mismatch between academia through the ability to deliver quality and relevant education and the manufacturing sector. Furthermore, the poor quality of education is also manifested by the inability of the manufacturing sector to adapt to new technological developments to deliver competitive customised products, new reconfiguration systems and machinery introduced to address the continuous changes in the manufacturing sector (Maheso *et al.*, 2018).

2.5.3 Environment challenges

Despite the benefits that industrialisation and foreign direct investments may have on the socio-economic development and prosperity of countries, it is widely recognised that the socio-economic transformations have a great potential to damage the ecosystem since most of these activities are associated with the exploitation of resources and manufacturing operations (Opoku & Boachie, 2019). It is further argued that massive FDI inflows will also degrade the environment through emissions of greenhouse gases that have negative consequences on climate change (*Ibid*). Similarly, Afeikhena and Olu (2019) and Piyathanavong *et al.* (2019) state that the rapid innovative development and capitalisation of the manufacturing sector have triggered all sorts of environmental problems for the planet, such as scarcity of natural resources, global warming, air pollution, drought, among others.

South Africa accounts for almost half of the gas emissions on the African continent in terms of emissions per unit of the GDP or per capita emissions (Moyo, 2016). These gas emissions represent the biggest threat to humankind's survival and the planet despite the role played by manufacturing firms in curbing the impact on the environment by promoting technological innovation and economic development (Afeikhena & Olu, 2019; Piyathanavong *et al.*, 2019). With this high level of gas emissions, Botha (2015) points out that South African manufacturing firms should mobilise actively to add a positive response to climate change as part of their corporate strategies to revolutionise the manufacturing sector and maintain sustainable development.

2.5.4 Legislative challenges

South Africa possesses progressive and sound legislation on manufacturing, but inefficiencies impede the legislation in its implementation. As a result, it has been regressing on the global competitiveness stage since 2017 and has not been able to drive investments in productive capacity that ensures locally produced goods are competitive in the worldwide market (Matsangou, 2019). TIPS (2016) reports that for policies to be relevant, they need to be reviewed periodically to improve their implementation and impact through continuous learning and adjustment to meet and anticipate industrial developments. Similarly, Macpherson (2018) emphasises that incentive programmes in the manufacturing must be revitalised, destructive policies removed, and new ones developed with much and greater emphasis on long-term objectives. It is essential to mention that opposition parties, non-governmental organisations and the civil society have repeatedly challenged corporate legislation through court battles as they argue that the bill is poorly drafted and lacks substantial incentives to promote, drive the manufacturing and make South Africa the prime destination for foreign investments (Macpherson, 2018).

Given the importance that the power supply plays in the development of the manufacturing sector, Mjimba (2016) posits that South African legislation requires some structural changes to effectively promote the manufacturing as the key driver of balanced growth and reduce gross inefficiencies at state-owned enterprises such as Eskom, which is a state-owned power utility, Denel and among others. Mjimba (2016) perceives that the dominant position held by Eskom represents the root cause of its mismanagement and lack of efficiencies. Macpherson (2018) also reports that investors, particularly in the manufacturing sector, are disinvesting in South Africa as they perceive that the Protection of Investment Act does not provide adequate protection for foreign investments.

2.5.5 Political challenges

Despite the strides made by the South African Government to improve the lives of its people and the economic conditions of the country, the legacy of apartheid still shapes the economic, social and political landscape, resulting in serious challenges that need determined efforts to deal with to restore the dignity of previously disadvantaged people, reduce inequality and dismantle the past structural discriminatory system (Shoba, 2018). It is further stressed that the Government is struggling to create job opportunities for the working class, eradicate crime and the widespread poverty as well as reduce inequalities (*Ibid*). Mjimba (2016) alludes that the Government is also facing considerable hurdles to create a robust infrastructure development to support the manufacturing sector and other primary pillars of the economy. Furthermore, Mjimba (2016) and Nordea Trade (2020) argue that the state-owned enterprise Eskom represents the main supplier of power in the country and that the position it holds is the cause of inefficiencies in the operations to supply power. These inefficiencies are the result of lack of adequate maintenance, corruption activities as well as obsolete equipment, which lead to supply deficits and negative impact on the manufacturing sector and other sectors of the economy, hence slowing the development and competitiveness of the manufacturing sector (Nordea Trade, 2020).

Recent political developments in the country, such as factional battles between members of the governing party, the poor policy implementation as well as state capture have exasperated political volatility and affected investments in the manufacturing sector, prompting investors to move their assets offshore (Maverick 2018). Furthermore, according to Maverick (2018), the instability of the political climate has also affected the exchange rate and the input cost of the manufacturing, making it very difficult for manufacturers to plan and execute their strategies properly. Similarly, the political instability in South Africa and weak business confidence, as well as international economic uncertainty, have contributed to slow the economic growth for 2018 (Binge & Boshoff, 2019).

South Africa needs to acknowledge these different challenges it faces and work towards fostering a conducive business environment with the aim of attracting foreign investments through sustainable incentive programmes. It is also important to emphasise that although South Africa possesses an intensive potential to develop its manufacturing sector than the rest of Africa, the Government must have a clear vision of its economy to tackle the challenges it faces and develop sectors in which the country has a competitive advantage. Without a sound strategy and conducive business environment, supported by relevant and comprehensive economic, political and legislative frameworks, there will be no significant appetite for potential investors to invest in the country. The Government must devote substantial investments in education and skills development programmes of its population, promote innovative activities, research and development to support the long-term development of the manufacturing sector and spur the economic growth of the country.

2.6 MANUFACTURING SECTOR IN THE CONTEXT OF ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability refers to environmental practices that regulate the use of the planet's resources to meet the needs of the present without jeopardising the ability of future generations (Niehaus *et al.*, 2018; Okolo, 2018). In recent years, the world has experienced severe consequences (drought, global warming, earthquakes, floods and among others) of climate change, which are widely attributed to human activities (Dubey *et al.*, 2017). Dubey *et al.* (2017) further stress that the harmful emissions from human activities pose severe threats to the development and survival of humanity and the ecosystem in general. The manufacturing development needs to be considered in the context of sustainability as the manufacturing sector represents a significant contributor to carbon emissions, resource depletion and environmental degradation (Oguntoye & Evans, 2017; Bag *et al.*, 2018).

South Africa is responsible for the highest level of carbon dioxide emissions in Africa, representing 42.8 per cent of the total carbon emissions on the continent and ranks fourteenth at the international stage (Sarkodie & Adams, 2018; Salahuddin *et al.*, 2019). Moreover, the authors argue that the high degree of environmental pollution places enormous pressures on the South African Government to show its commitment to curb the impact of business activities on the environment and start investing in practices that promote sustainability. Similarly, Bohlmann *et al.* (2019) stress that, under the Paris accord ratified in 2015 by South Africa and other nations across the world, governments committed to limit the rise of global temperatures by promoting sustainability through technological development and innovation as well as incentive programmes to foster the adoption of practices that will ultimately reduce the harmful effect of business activities on the environment. Russo and Von Blottnitz (2016) stress that during the Paris accord, South Africa committed to reducing its greenhouse gas emissions by 34 per cent and 42 per cent against business-as-usual emissions by 2020 and 2025, respectively.

Evidence suggests that green initiatives are emerging sustainable development concepts aimed at improving environmental performance as well as economic performance (Dubey *et al*. 2017); Liu *et al.*, 2018); Ali *et al*., 2019). The adoption and implementation of green supply chain practices in the manufacturing sector have the potential to improve organisational performance and reduce the effect of business activities on the environment (Kirchoff *et al.*, 2016; Roehrich *et al*., 2017). Moreover, it is suggested that green supply chain activities allow organisations to build green industrial brands and support environmental sustainability throughout the supply chain networks (Sahu *et al.*, 2018).

Owing to the threats mentioned above to the environment, coupled with the desire to improve environmental performance and long-term sustainability of the South African manufacturing, the current study proposes a comprehensive conceptual framework for the implementation of green supply chain management, dynamic capabilities and supply chain performance based on a critical literature review of peer-reviewed articles. The study also emphasises on the need for professionals to translate the theoretical knowledge provided as a sound resource to implement GSCM practices in the manufacturing sector. The study finally offers directions for further research in this field for academics as well as provide a better understanding of the concepts of green supply chain management, dynamic capabilities and supply chain performance.

2.7 AUTHOR’S IDEA AND ANALYSIS

A holistic review and analysis of this chapter demonstrates the important role the manufacturing sector plays in societies at large which is to create jobs, set condition for industrialisation, promote economic growth, drive innovation, and reduce poverty and inequality. Despite its importance, data provided in Figure 2.4 of this chapter show that the South African manufacturing sector did not take advantage of globalisation and trade openness. Figure 2.4 indicates that the South African manufacturing sector has been struggling since the dawn of democracy. Its contribution to the total GDP has decreased sharply from 20 per cent during Apartheid to 14 per cent in 2016.

However, it is important to also recognise that the legacy of apartheid accrued in a low level of productivity and reduced level of competitiveness since the participation of non-whites in the economy was limited. In addition, the statutory job reservation system hindered the prospect of growth and economic development of South Africa and the manufacturing sector in particular. The decline in output contribution to the total GDP should be worrisome for the South African government since its desire when it joined the Trade World Organisation was to improve the socioeconomic condition of the country specially in a context of rising unemployment rate, crime, poverty and inequality. One can argue that the policies introduced after 1994 which aimed at liberalising trades with the outside world, attracting FDI and promoting technological development have rather benefited competitive countries given the fact that importation did not actually match exportation. Since the ratification of trade liberalisation agreements, foreign goods in the country started to increase rapidly while exportation remained weak (Statistics SA, 2018). This indicates a low level of competitiveness and the inability of South Africa to embrace technological development to match globalisation. What is happening in the macroeconomic level and the manufacturing sector in particular tends to suggest that policies developed by the South African government have failed and continue to fail because its comparative advantage in terms of labour-intensive did not come to realisation and the manufacturing sector still performs poorly.

Furthermore, a large pool of African people which represent the majority in term demography is still unskilled, the manufacturing is becoming more and more capital intensive, unemployment rate is rising quickly, and crime is rampant. Owing to this statement, it is imperative that the South African government develops policies that foster the employability of its citizens, make the manufacturing sector labour-intensive since the trajectory taken by the manufacturing firms seems to be capital intensive, prioritise incentives for manufacturing firms since they have been or are still minimal, skill its population in areas needed to promote economic, technological development and environmental sustainability. In addition, these policies must also focus on developing reliable electrical infrastructures as operations in the manufacturing sector depend on reliable and consistent supply of electricity. The unsustainable energy supply continues to cripple the productivity of the manufacturing sector hence, losing billions of rands each time there is blackout (Ateba et al., 2019).

Sustainability requires that the manufacturing sector not only focus on generating profits for their shareholders but also taking care of the environment and the society. South Africa is responsible for the highest level of carbon dioxide emissions in Africa, representing 42.8 per cent of the total carbon emissions on the continent and ranks fourteenth at the international stage (Sarkodie & Adams, 2018; Salahuddin et al., 2019). To stay afloat in the global market, it is important that the manufacturing sector ensures high-level of performance by embracing modern manufacturing practices which include green supply chain management. This assertion was echoed by Mutingi, Musiyarira, Mbohwa and Kommula, (2017) who suggested that firms have to consider sustainability based on the triple-bottom-line concepts which advocate incorporating into the firm strategies three performance measures which include economy, environmental and social performances. Green initiatives represent the essential and sole strategy to help archive the triple bottom line.

2.8 CHAPTER SUMMARY

This chapter was intended to provide a literature review of the manufacturing sector across the world with a greater emphasis on the South African context. The literature revealed that the legacy of apartheid accrued in a low level of productivity and competitiveness of the manufacturing sector, widespread poverty and inequalities, high unemployment rate and low level of education among black communities. The transition to democracy has given some form of hope for the socio-economic development of the country, but this did not materialise at the full potential due to the lack of competitiveness of the manufacturing sector, lack of skilled workforce and inappropriate infrastructure. The chapter recognises that the manufacturing sector in South Africa and elsewhere, represents a catalyst for economic development and growth and it is at the centre of modern industrialisation and technological innovations. The recognition pertaining to the manufacturing sector is driven by its ability to reduce poverty, unemployment, inequalities and fight crime. Accordingly, these attributes will not materialise without sound regulations and appropriate policy implementations to match the changes in the business environment. The chapter further suggests that regulations and policies play a principal role in stabilising the macroeconomic conditions of a country, attracting foreign investors and motivating local entrepreneurs and business communities at large to invest in domestic activities instead of taking their operations outside the country’s borders.

Moreover, the chapter postulates that operation activities from manufacturing represent the greatest threat for humankind and the planet. Government and investors need to work together to find an overall balance between the creation of wealth for shareholders and meeting environmental requirements. If the balance is attained, it will help to create a green brand and footprint for organisations and South Africa as well as secure environmental sustainability. Embracing the practices of GSCM will pave the way towards achieving economic, social and environmental performance for organisations as well as promote the well-being of populations across the world.

The next chapter elaborates on research theories that guided the study and provides further discussions on GSCM.

CHAPTER 3

THEORETICAL FRAMEWORK AND GREEN SUPPLY CHAIN MANAGEMENT

3.1 INTRODUCTION

The purpose of this chapter is to analyse and discuss literature on GSCM in the manufacturing sector across the world. This exercise is motivated by the view that human activities continue to amplify to the point of creating all sorts of environmental and social concerns to the growing demography. The increase in resource scarcity, environmental damages and the negative effects on climate change have prompted practitioners, academics and activists to raise awareness of the ramifications of industrial activities on the well-being of human development, which have resulted in developing measures to help reduce and counter further degradation of the ecosystem. At the centre of this fascinating initiative are the practices of environmental sustainability, which include GSCM. The current chapter starts by elaborating and discussing three theories that were identified and found essential to guide the study. It further examines GSCM and its selected practices, its drivers and challenges as well as its importance in the manufacturing sector. Moreover, it provides a research gap analysis of previous studies on GSCM as well as some evidence of studies conducted on GSCM in the manufacturing sector in the international as well as South African contexts and ends with the chapter summary.

3.2 THEORETICAL FRAMEWORK

Theories are essential ingredients that help describe and explain the phenomenon of human existence. The theories under consideration in the study are selected since they contribute to understanding better how to relate contextual conditions, which include the characteristics of GSCMPs up and downstream the supply chain networks to SCDCs representing the firm's internal and external resources. The theoretical framework that is built discusses the application of three theoretical concepts, namely IT, DCT and CT that the researcher has identified and explored, based on existing literature and found relevant to the current study to tackle the challenges faced by the South African manufacturing sector; furthermore, provide means and strategies to practitioners to improve the competitiveness of their firms through the implementation of GSCMPs.

3.2.1 Institutional theory

The adoption and implementation of green innovation as a result of institutional pressures contribute to promote product differentiation and help to achieve sustainable competitive advantage (Chu *et al.*, 2018; Ahmed *et al.*, 2019). IT suggests that for firms to claim the legitimacy of their operations, foster their long-term economic development and increase their business survival rate through access to important resources, they need to ensure that social and environmental requirements set out by institutional forces are met (Kalyar *et al.*, 2019). According to Younis and Sundarakani (2019), the motivation behind the adoption and implementation of GSCM by firms is not only related to efficiency but rather to the desire to achieve social legitimacy and business sustainability. Tooranloo *et al.* (2017) also posit that since the emergence of GSCM, institutions have increasingly intensified their pressures on firms to achieve environmental sustainability and stimulate consumer demands for green products. From these views, it can be perceived that institutional constraints promote, encourage, control and enforce the compliance with environmental standards, although the main purpose of firms is to generate profits and create wealth for their shareholders. IT further demonstrates that profits and the wellbeing of the populations can be achieved simultaneously through ecologically friendly practices in the entire supply chain. For instance, in more developed countries, where regulations on the environment are more stringent, firms are likely to adapt and implement environmental sustainability.

A study by Li *et al.* (2019) contrasts the above perspective by stressing that institutional processes provide diverse outcomes regarding the adoption and implementation of green initiatives since the availability of resources and the ability to embrace technological changes represent factors that define and demarcate one firm from another in the business environment. As a result, it can be argued that the availability of resources as well as the organisational culture through the inspirational drive of the upper management plays a mediating role in defining the adoption and implementation of green practices.

Institutional pressures or forces can be classified into external forces, which include government policies, professional bodies and customers' requirements and internal forces comprising organisational resources and the ability to embrace change (Li *et al*. 2019). This view is also supported by Malik *et al.* (2019), who identify two forces and stress that external and internal forces play a distinctive role in promoting the adoption and implementation of GSCM. These two factors, more specifically, external forces, play a critical role in influencing firm decisions to pursue the implementation of green practices for sustainable socio-economic development (Foo *et al.*, 2019). Firms have increasingly and repeatedly been exposed to external forces resulting in isomorphism mechanisms. The theory establishes three basic forms of institutional isomorphism to echo the type of influence exerted on firms by institutionalisation, namely coercive, normative and mimetic isomorphism (Choudhary & Sangwan 2019; Kalyar *et al*., 2019; Li *et al.*, 2019), discussed in the next sections.

Coercive isomorphism occurs as the result of pressures from governmental policies and customer expectations since the success of companies depends (finances, cultural expectations, among others) upon them (Dubey *et al.*, 2018; Ahmed *et al.*, 2019). Kauppi and Hannibal (2017) also argue that coercive isomorphism derives not only from government legislation but also from social movements, which include activist movements, non-governmental organisations (NGO) and consumers. It is witnessed that these forces play a leading role in the implementation of GSCM and one can argue that the level of dependence to these actors (Government, activists, NGO and consumers) gives no choice to companies rather than the obligation to ensure compliance with spelt requirements to avoid punitive measures such as fines, penalties and the boycott of their products or services, among others. The fulfilment of the conditions will undoubtedly afford companies to gain legitimacy to operate freely and get access to necessary resources, which include labour, raw materials, incentives, among others.

Normative isomorphism is a consequence of pressures originated from professional specifications and standards within a specific industry which often go beyond legal requirements that all members must comply with (Choudhary & Sangwan, 2019; Kalyar *et al*., 2019). Kauppi and Hannibal (2017) argue that normative isomorphism can also be exerted through formal training aimed at equipping personnel with the knowledge that will allow them to perform their duties with confidence and reliability in the required domain, which, in the context of the current study, is the sustainability. Sayed *et al.*, (2017) also stress that normative pressure comes from professional alliances within an industry sector and members of the industry are perceived to be legitimate when they comply with norms that govern the industry. Mbelwa (2015) posits in the normative system, members of the industry define conditions and methods of work appropriate to their context, put in place control mechanisms to monitor business activities and establish a cognitive base for their occupational autonomy. As the result of this assertion, one can argue that normative mechanism can help to standardise environmental practices within all industries of a particular sector, bring new insights to advance research development and innovation and promote ethical behaviour across the sector as a result of normative rules developed by the alliances.

Mimetic isomorphism argues that firms are under pressure to imitate the industry's best practices in the time of uncertainty by remodelling their business strategies (Dubey *et al.*, 2018; Kalyar *et al.,* 2019). Similarly, Kauppi and Hannibal (2017) posit that mimetic pressure can be characterised as an act of responsiveness to uncertainty where the prospect of success is blurred, and the only safer way out is to imitate competitors. The reflective view entails that during volatile situations such as political and market instabilities, economic downturns, technological deficiencies among others, firms are forced to rethink their processes, operations and strategies to enable them to seek opportunities and ensure that their supply chain networks remain efficient and responsive to market demands.

Based on the above, one can conclude that IT is transferred through coercive, normative and mimetic pressures. These help organisations to harmonise activities within their respective sectors, resulting in legitimacy and increased efficiency. The theory helps explain whether the compliance path undertaken by firms regarding the respect of environmental requirements is driven by internal or external factors. The theory further provides insights on how organisations interpret institutions in their processes and operations as well as show the way legislation and regulations are perceived in matters concerning environmental sustainability. It finally helps understand the interaction between lawmakers and organisations and how pressures shape these organisations.

3.2.2 Dynamic capability theory

Evidence suggests that sustainable supply chain practices have often been explained through the impulsion of the resource-based theory (RBT) on how to deploy and manage resources and skills within organisations to achieve competitive advantage

(Liu *et al.*, 2016; Gruchmann *et al.*, 2019). Eltantawy (2016) and Dias and Pereira (2017) argue that having valuable, rare, imitable and non-substitutable resources as preconised by RBT is necessary but not enough to sustain short and long-term competitive advantage since the RBT neither explains competitive advantage in complex environments nor helps modify or improve routine activities in the value and supply chains. Yu and Ramanathan (2016) point out that RBT views firms as a bundle of resources that can be used to achieve competitive advantage through intra-firm resources and capabilities. Given the inherently static nature of the RBT (Dias & Pereira, 2017; Gruchmann *et al.*, 2019), which does not address the constant changes that can occur in the marketplace; the question which arises is how to compete effectively in a volatile market where technological innovation and development are required to achieve competitive advantage using resources of a given company?

To effectively compete in a dynamic environment as a result of trade openness, technological innovation and the high level of diversity in the manufacturing, Kuuluvainen (2012), Eltantawy (2016) and Gruchmann *et al.* (2019) believe that some aspects of dynamic perspectives need to be introduced into the core functions of RBT to enable the theory to explain how firms can strategically behave to achieve sustainable development in dynamic environments. Hence, DCT describes how firms can adjust and reinvent themselves in a vibrant manufacturing sector to match the ever-changing needs of customers through technological innovation and development (Dias & Pereira, 2017). Furthermore, Gruchmann and Seuring (2018) allude that DCT is an extension of RBT, which includes the ability to integrate, build and reconfigure internal and external competences to tackle the volatile and changing environment rapidly.

To survive in a challenging and dynamic environment such as manufacturing, firms need to build, adapt, refine and reconfigure their strategies to absorb the effects of constant changes. Consequently, recognising the intrinsic values of DCT, Mohamud and Sarpong (2016) allude that firms are required to possess DCs that will enable them to sense, size and transform opportunities in volatile markets. Similarly, Aslam *et al.* (2018) stress that in unstable and unpredictable environments, firms need to have DCs to explore new opportunities and exploit existing efficiencies within their operations to remain competitive and survive turbulent periods. Raman and Bharadwaj (2017) also stress that developing and adopting DC will allow firms to generate, scan, select and apply existing and new knowledge that could result in positive and productive outcomes. Arguably, these assertions demonstrate the relevant role played by the DCT in fostering the short and long-term success of firms by helping them to find a fit between internal competencies and the organisational strategy, as well as a fit between external competencies and the overall organisational structure through effective deployment of resources. These assertions further portray the tenacity and dynamism of DCT in periods of turbulence resulting in the transformation of resource-based firms into competitive entities with substantive dynamic capabilities which can be used to respond to market demands effectively and efficiently.

In contrast, some authors (Andreeva & Ritala, 2016; Liu *et al.*, 2018; Gruchmann *et al.*, 2019) argue that DCT possesses a complex character in its conceptualisation, which makes it very difficult to consolidate and provide a common outcome. Andreeva and Ritala (2016), Liu *et al.* (2018) and Gruchmann *et al*. (2019) classify DC into two different categories, namely domain-specific, which suggests that DC are built within an organisation and embedded in it, given it a distinctive character and generic DC, which bring some commonalities of DC features across many firms leading to competitive advantage, although each entity is unique. Schweizer *et al.* (2015), Kalali and Heidari (2016), Mohamud and Sarpong (2016) and Souza *et al.* (2017) also conceptualise DCT a meta-theory of strategic change by combining strategy and change perspectives to demonstrate the difference in scope, performance and behaviour among companies. Some other studies stress that the DCT is based on knowledge evolution and learning to develop DC to achieve a sustainable competitive advantage (Singh & Rao, 2016; Dias & Pereira, 2017; Raman & Bharadwaj, 2017). Other studies argue that the DCT is still at an early stage resulting in a low level of support within small business spheres (Wang, 2016; Dias & Pereira, 2017).

Considering research works of these authors, one can argue that there is no universal consensus about the conceptualisation of DCT as well as its outcome in terms of holding on the promise of providing a sustainable competitive advantage. It is also important to mention that DCT was developed to solve the weakness of RBT, but unfortunately, some studies suggest that the theory has limitations. The study offers a different perspective by building on the path dependency of the DCT in the context of GSCM to achieve supply chain performance in the South African manufacturing sector. The study provides conceptualised causalities in chapter four by considering the relationships between GSCM practices, DC and supply chain performance.

3.2.3 Contingency theory

Contingency refers to uncertainties or unpredictable events that occur in marketplaces outside the solid sphere, which have the potential to affect its survival (Alves *et al.*, 2017; Yuen & Thai, 2017) significantly. Uncertainties such as customer demands, competitive level, technological risk and supplier uncertainty force firms to take steps in implementing drastic measures that would help minimise and counter the effects of uncertainties in an effective manner (Hallavo, 2015). These countermeasures derive from internal restructuration initiatives undertaken by firms, which include a change in strategy, change in organisational culture, change in operational processes, adoption of new technology and upper management commitment, among others (Alves *et al.*, 2017).

In the context of high uncertainties, CT through its strategic response is one of the most important and relevant factors that can help reduce and curb the effects of market turbulences in firms (Hwang & Min, 2015; Alves *et al.,* 2017). For instance, the global stock market has been falling recently due to price war between Russia and Saudi Arabia on oil issues, exacerbated by the discovery of COVID-19 (Coronavirus), which has triggered a complete lockdown of businesses around the world and in South Africa in particular. The complete lockdown aims at curbing and minimising the spread of the virus. The question that arises is what happens afterwards? After the containment or eradication of the pandemic, businesses around the globe need to find a strategic response to restore the full operationality of their processes and strive to recover losses they incurred as the result of the COVID-19 that led to the complete lockdown, hence the importance of contingency theory.

Contingency theory advocates that in times of uncertainty and economic turbulences, firms must embrace the best practices that can enable them to find the appropriate fit between their business strategies and the environment since there is no unique or exclusive way of applying the theory (Hallavo, 2015; Kros *et al.*, 2019). Yuen and Thai (2017) suggest that CT does not support the principles of universality, it instead holds on to the adequate match between internal organisational structure and external contextual factors which influence the performance of the firm. Similarly, Zarei *et al.*

(2019) indicate that contingency factors in market environments which are not controlled by firms dictate the course of actions to take to find adequate responses based on their own internal resources and capabilities.

A study by Kros *et al*. (2019) postulates that managers in companies are highly dependent on the contingency theory to make sound decisions as it contributes to mitigate risks, manage quality and complexities that may arise in the supply chain networks. It is further argued that the theory represents a tool that allows managers to restructure and organise their firms, make strategic decisions in a way that establishes a comprehensive fit between internal operations and external conditions (*Ibid*). Smith *et al.* (2019) posit that how operations in firms are structured highly depends on the operating conditions of the external landscape. This perspective suggests that firms design their operating activities in consideration of the characteristics of the external environment.

A study conducted by Omotosho and Anyigba (2019) in the Nigerian manufacturing industry, which combined contingency, entrepreneurial and agency theories to form a single framework aimed at demonstrating how these theories contribute to support a sustainable competitive advantage, suggests that CT is situational, signifying that there is no notion of one-size-fits-all as developments in the environment determine the organisational strategy and the type of leadership style that best suit the situation to achieve corporate performance.

A study by Dikova *et al.* (2016) adopted the contingency approach to study the performance of multinational enterprises (MNEs) and subsidiaries. It suggests that, for MNEs to successfully perform outside their traditional markets, it is critical to understand local environments in which their subsidiaries will be established since their understanding will allow them to effectively evaluate the type of capabilities needed to develop high-performance subsidiaries. Consequently, the contingency approach entails that to enter foreign markets, MNEs must find the appropriate balance between international standards and adaptative strategies in line with host country needs and legislations, develop partnerships with local companies or set a subsidiary as a greenfield. The main exercise in this context is to find the appropriate fit between the internal attributes of MNEs and foreign environments that will lead to improved performance.

A study by Moore *et al.* (2018) examined the relationship between contingency factors and reshoring drivers in the US textile and apparel industry and used CT to explain contingency factors such as the size of firms, industry and product types that influence the decision of the firm to reshoring. The study through CT provides information about the company's motivation that may be developed to address issues of sustainability.

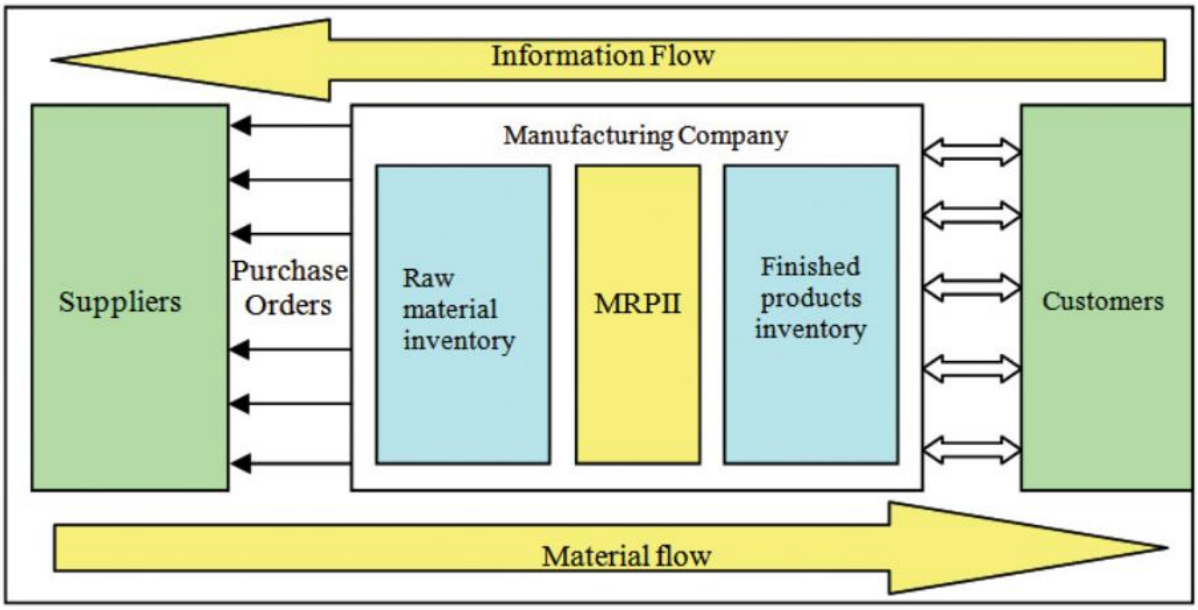
From the above developments, one ought to argue that CT is governed by two essential variables, namely: the firm-specific variable, which includes the ability of the firm to restructure, reorganise, adapt or develop new strategies, rapidly embracing technological development and train workforce to face new challenges; and the environmental variable, which results from the ever-changing market demands, the level of competitiveness, the technological uncertainty and the currency fluctuations, among others. Let us emphasise that it is the environmental variable through its volatility and uncertainty characteristics that triggers the appropriate reaction or response of the firm-specific variable; hence, the latter plays a moderating role in achieving organisational performance. Consequently, CT can be resumed as an organisational theory that claims that there is no universal way to lead a firm.

The course of action to be taken by a firm is determined by external developments or a situation at hand of which the firm has no form of control. The theory suggests that in times of complexities as well as high levels of uncertainties, firms must strengthen their internal resources and capabilities through learning, technological innovation and other means that will enable them to improve their performance. Moreover, it is understood that the effectiveness of leadership style is highly contingent on the situational context. Finally, CT facilitates better strategical, tactical and operational decisions by the leadership to enable performance improvement in the supply chain networks, which can ultimately lead to sustainable competitive advantage.

3.3 GREEN SUPPLY CHAIN MANAGEMENT

Supply chain management has been gaining popularity and importance since 1982 through the inspirational drive of Keith Oliver, a British logistician and consultant. At the time of the coinage of the term "SCM", it spanned all activities in the supply chain networks, from the acquisition of raw materials to the distribution of final products to consumers as per Figure 3.1 (Gurtu *et al.*, 2015; Talatappeh & Lakzi, 2019). The traditional SCM concept aimed at reducing cost and improving service performance with little or no attention to environmental issues (Dubey *et al.*, 2017). Over the years, the concept of SCM has expanded from its traditional setup to include environmental concerns, hence the terminology "green" was incorporated to SCM resulting in GSCM (Gurtu *et al.*, 2015; Sahu *et al.*, 2018). Compared to the traditional concept of SCM that has no attention to the adverse environmental effects, the new concept of a green supply chain is characterised by green procurement of raw materials, green production, green distribution of the final products and green consumer services, hence forming a close-loop (Kazancoglu *et al*., 2018). This says that in all interfaces (customers/manufacturer, manufacturer/suppliers and production phases) of the traditional SCM in Figure 3.1, green thinking needs to be included.

Figure 3.1: Traditional Supply Chain Management



Source: Dos Santos *et al*. (2010).

Figure 3.1 illustrates a classic traditional SCM setup of a small to medium-size enterprise based on Dos Santos et al.*'s* (2010) work where the manufacturer relies on sales forecasting of its customers to plan its production. Once the order is received from its customers, the manufacturer then sends the purchase order to its suppliers via a Manufacturing Resource Planning (MRPII) software, which is an integrated programme designed to process information and plan its production. The receipt of raw materials from suppliers triggers the manufacturing process and the finished products are then sent to customers. If there are deficiencies in the products shipped to customers, the information is then sent back to the manufacturer, then upstream to the supply chain if applicable, hence forming a closed-loop system.

Green supply chain management refers to the process of integrating environmental thinking into the SCM, which includes product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life (Ahi & Searcy 2013, as cited by Maditati *et al*. (2018:150). GSCM can also be described as green procurement and manufacturing activities, which encompasses green design, manufacturing and recycling according to green standards (Zhu & Sarkis, 2006, as cited by Kazancoglu *et al*., 2018:1283). GSCM refers to the management of material, information and capital flows as well as cooperation among companies on environmental issues derived from customer and stakeholder requirements (Roehrich *et al.*, 2017:490). Finally, Tseng *et al*. (2018) define GSCM as the process of developing and implementing environmental initiatives into the supply chain networks, which includes reverse logistics.

From the four definitions provided, one can argue that the concept of GSCM is broad as authors define GSCM differently and according to how they view and understand it. Since the concept of GSCM covers a broad spectrum of environmental practices and applications, it makes the adoption of a standard and single definition, as well as a common framework difficult. Therefore, based on the review of these definitions and the descriptions in the literature, the study proposes the following operational definition: GSCM refers to as a set of practices that aims at reducing the impact of supply chain activities on the environment while promoting performance improvement for all members of the supply chain networks. This definition implicitly provides a dual focus, which comprises the supply chain and the planet that are important when a firm needs to compromise natural resources to achieve organisational performance. Despite the differences in defining GSCM as well as in conceptualising it, there is some commonalities in the purposes which are eventually to reduce the negative impact of business activities on the environment. In the current study, GSCM is defined along seven dimensions that are discussed in Section 3.7.

Evidence suggests that GSCM continues to attract the attention of practitioners since they are starting to understand the benefits (enhanced reputation, increased efficiency and effectiveness, differentiation and revenue growth) that bring the implementation of green practices (Kirchoff *et al.*, 2016; Tumpa *et al.*, 2019). Kirchoff *et al.* (2016) and Tumpa *et al.* (2019) further argue that GSCM is a valuable tool that must be used by firms to add value to their products as well as foster long-term economic prosperity, environmental performance and sustainable competitive advantage. Moreover, GSCM is considered as a catalyst that enables firms to meet their organisational objectives, which include cost reduction, improved reputation and legitimacy and product differentiation, among others (Roehrich *et al*. 2017; Sellitto *et al.*, 2019).

Similarly, Dubey *et al.* (2017) and Sahu *et al.* (2018) stress that, worldwide, the field of GSCM has received tremendous contributions from academics and companies are starting to implement GSCM as a strategy to drive innovation, competitiveness and sustainability. For example, in the United Kingdom, retailers such as Asda, Tesco and M&S require their suppliers to reduce the effects of their activities, which include transportation on the environment and Wal-Mart in the USA, requested its suppliers to reduce the volume of their packaging to 5 per cent and reduce carbon dioxide emissions by as much as 667,000 m^3 (Noh & Kim, 2019). This is a clear demonstration that GSCM is spreading quickly across the world as all stakeholders understand the role it can play to save the planet from human activities through the implementation of sustainable supply chain practices. Doing business while protecting the environment through new technologies, process innovation, new strategies and international certifications such as ISO 14000 has become the new norm and primary goal for firms around the world (Rane & Thakker, 2019).

Green supply chain management plays various roles in organisations involved in supply chain activities, which consist of promoting environmental efficiency by reducing the harmful effects of business operations on the environment, by fostering the effectiveness of manufacturing activities and that of entire supply chain networks (Mardani *et al*., 2018). Sellitto *et al.* (2019) indicate that green practices cannot be treated and evaluated in isolation or independently as they require effective communication and collaboration among partners and cooperation with suppliers. Linking to this view, one can stress that the importance of green practices is determined by the interaction with members of the supply chain networks. This view is supported by Sellitto and Murakami (2018), who analysed in their study the relationships between a steelmaking plant in Brazil, vendors and other business partners in a network of industrial companies. The study found that there is a strong dependency between firms and external factors such as logistics, regulations, among others. A survey by Noh and Kim (2019) also addresses the importance of cooperation with members of the supply chain to make efficient contracts that they called SCM contracts. The study used a single manufacturer and multiple retailers (SMMR) model to evaluate the performance of the supply chain in terms of green practices and found that cooperation is optimised when companies collaborate.

3.4 DRIVERS OF GREEN SUPPLY CHAIN MANAGEMENT

Drivers are forms of pressures such as regulatory and stakeholders' pressures exerted on firms aimed at encouraging them to implement GSCM (Tseng *et al.*, 2018). The study does not assume that the adoption and implementation of GSCM into the supply chain networks automatically lead to supply chain performance, but instead explores through a comprehensive review of literature the possible factors that could serve as motivators to encourage the implementation of sustainable practices. This exercise sets out the context of the study and the following section discusses the main drivers that stimulate the application of GSCM.

Since the topic of GSCM has been gaining attention within academics and practitioners, the need to develop a sustainable supply chain model which includes the drivers of environmental sustainability has also seen a rise (Bhardwaj, 2015). GSCM has become a strategic weapon to outperform competitors and firms may engage in the adoption and implementation of green practices as a result of strong forces emanating from within or outside their sphere. Pressures such as customers, governments, media, non-governmental organisations and employees represent substantial factors to drive the implementation of green practices (Chen & Kitsis, 2017).

A study conducted by Wang *et al*. (2018), based on 246 firms in multiple countries, revealed that cost and customer drivers influence the implementation of GSCM, which ultimately leads to enhanced environmental performance. It is argued that customers may use their purchasing market power to exert pressures and facilitate the implementation of GSCM through communication and collaborate channels with suppliers and manufacturers on matters concerning environmental sustainability

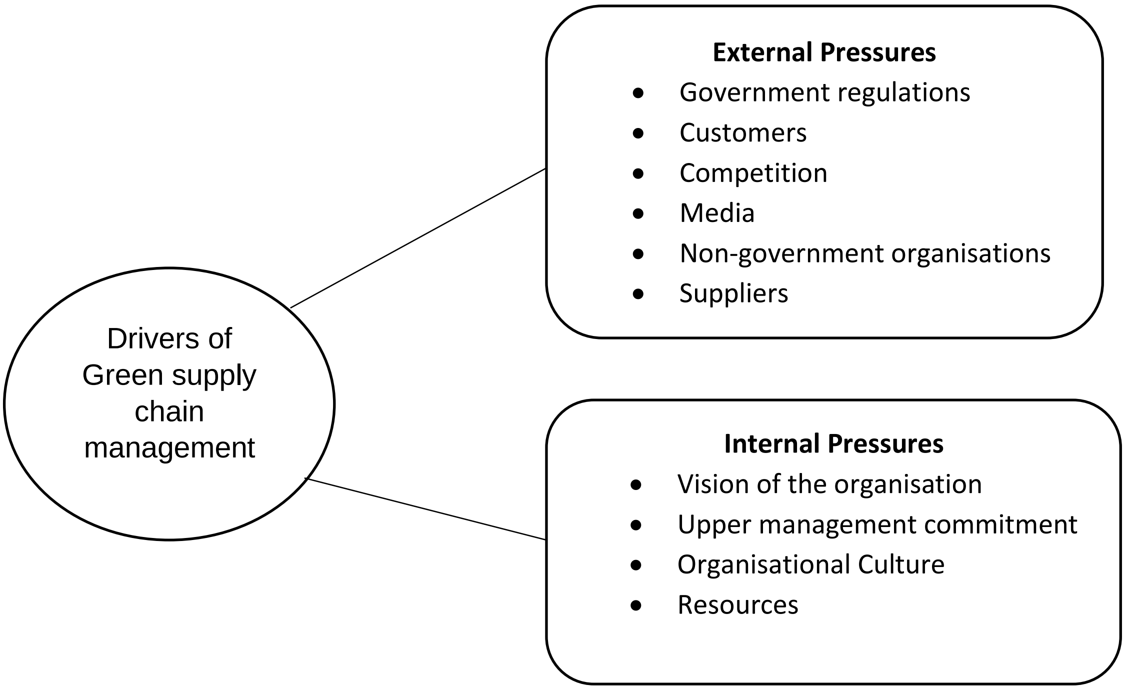
(*Ibid*). It is also indicated that acquiring environmentally friendly products from suppliers may have the ability to increase costs, which include the cost of materials, cost of training, among others and reduce the level of competitiveness of the buying firm (*Ibid*).

This view was refuted by Chen and Kitsis (2017), who argue that to meet long-term objectives, firms must embrace GSCMPs since they contribute to the increased efficiency of the supply chain, the return on investment, the market share and help to achieve sustainable competitive advantage. This assessment is also supported by Singh and Misra (2019), who allude that firms that adopt and implement green practices are highly likely to remain competitive in their respective industries and likely to meet the evolving needs of consumers, which can result in an increase in market share as well as in profitability.

A study by Huang *et al.* (2017) identified two categories of pressures on firms to achieve SCP: external pressures such as regulations, government involvement, customers, competitors, society and suppliers and internal pressures, which include environmental vision and policy statement, the commitment of resources for green initiatives, support action of GSCM and interpretation of environmental issues. The study has integrated these two categories of pressures into institutional theory, steward theory and view of performance to investigate the antecedents and consequences of GSCM. The findings indicate that first, institutional forces affect the GSC initiatives of firms. Second, institutional pressures influence the environmental stewardship behaviours (ESBs) of managers. Third, the ESBs of managers affect the GSC initiatives of firms. Fourth, the GSC initiatives of firms influence their environmental performance, economic performance and competitiveness. Fifth, the bootstrapping results reveal that institutional pressures indirectly affect the GSCM of firms through the ESBs of managers. The view was also echoed by Lo and Shiah (2016), who identified two factors that significantly affect the implementation of GSCM, namely external and internal factors.

Based on the developments above, the study concludes that pressures on firms can be classified into internal and external forces as per Figure 3.2.

Figure 3.2: The Drivers of Green Supply chain management



Source: Adapted from Chen and Kitsis (2017); Huang *et al.* (2017).

Figure 3.2 portrays external and internal pressures that contribute to foster and encourage the implementation of GSCMPs. To fulfil the growing and pressing needs of customers in the marketplace, firms need to enhance their productivity through efficiency and effectiveness by utilising new techniques such as GSCM. Embracing GSCM can help increase the viability of firms as well as their survival rate and competitiveness.

3.5 CHALLENGES IN IMPLEMENTING GREEN SUPPLY CHAIN MANAGEMENT

Despite the crucial and strategical roles played by GSCM in enhancing the environmental, social and economic performances of firms, there are still some growing concerns regarding its implementation. Several studies suggest that not all firms view GSCM worth pursuing because it requires a substantial amount of resources and human resources commitment to ensure successful implementation (Hsu *et al*., 2016; Tumpa *et al.* 2019; Zhu *et al.*, 2019). Moreover, Zhu *et al.* (2019) argue that firms are still casting doubt in adopting GSCM and tend to pursue green innovations when they perceive win-win outcomes such as economic gains and profound environmental opportunities and benefits.

Embracing sustainable supply chain practices comes with complexities in their scope and applicability, resource constraints and coordination issues (Vijayvargy *et al.*, 2017). Muchaendepi *et al*. (2019) and Tumpa *et al.* (2019) argue that the lack of top management commitment and the absence of adequate organisational structure are two barriers to the successful adoption of green practices throughout the supply chain. Furthermore, the study by Muchaendepi *et al*. (2019) in the mining sector in Zimbabwe based on 91 mining companies, finds that the absence of structural and organisational changes are key features that affect the implementation of sustainable practices.

A study by Keivanpour *et al.* (2015) in the aircraft industry addresses the opportunities and challenges faced by aircraft manufacturers in the implementation of GSCM. Their study suggests that obstacles such as lack of variety of green practices, resistance to change, uncertainty for applying novel technique such as green practices, the complexity of change, lack of relevant directives, risk and market competition represent real hurdles for businesses to adopt and implement environmental sustainability.

Furthermore, the lack of involvement of Government in developing adequate policies and regulations addressing decisive issues of environmental sustainability constitutes an obstacle to the implementation of GSCM since it creates a sense of hesitancy among manufacturers, suppliers and consumers (Rane & Thakker, 2019; Majumdar & Sinha, 2019). Zhu *et al.* (2019) argue that the state of hesitation generates uncertainty and absence of confidence in programmes meant at improving environmental performance. Moreover, Majumdar and Sinha (2019) allude that the lack of government support hampers the promotion of green activities within the supply chain networks as well as the management of environmental concerns such as pollution.

A study by Namagembe *et al.* (2016) aimed at advancing entrepreneurial orientation as a new internal driver for GSCM adoption in Ugandan SME manufacturing firms, suggests that regulations on environmental sustainability are fewer in developing countries and their enforcement lacks effectiveness, resulting in disregard of green practices and higher environmental pollution. Evidence also suggests that most firms, particularly in developing countries, adopt a reactive approach to GSCM rather than being proactive such that they anticipate solutions for potential environmental concerns (Soda *et al.*, 2015). Huang *et al.* (2015) and Soda *et al.* (2015) claim that the concept of GSCM is still at an early stage in developing countries, resulting in fewer companies implementing green practices and have a low level of environmental awareness.

The lack of monitoring and control of suppliers in the supply chain poses serious challenges and risks to the entire supply chain. For instance, KFC suffered a reputation loss in China when an industrial dye (Sudan Red one) which is used to colour non-food products were found in its chicken wings and hams. Through a thorough assessment and monitoring, it was detected that the dye originated from third-tier suppliers, hence the importance of collaborating, monitoring and controlling suppliers (Zhu *et al.*, 2019).

The firm size plays an essential role in the adoption and implementation of GSCM as well as its ability to proactively tackle environmental issues through a systematic scanning of the environment (Younis *et al*., 2016). SMEs find it very difficult to deploy resources to green initiatives as they do not perceive any potential short-term benefits (*Ibid*). Similarly, Huang *et al.* (2015) and Vijayvargy *et al.* (2017) suggest that small size businesses are more concerned about short-term objectives than long-terms and invest less on green technologies as a result of lack of financial resources, lack of adequate equipment, lack of knowledge and skills in green operations. Moreover, the lack of innovative ideas in advancing product development and processes affects the endeavour of small businesses towards embracing green initiatives (Namagembe *et al.*, 2016).

Small to medium enterprises are faced also with challenges to secure financing for their working capitals since banks view them as great risk bearers with no or little collaterals and are reluctant to provide them loans (Song *et al.*, 2019). Gaining access to financing is very important for their survival, growth and development, especially in a period of economic downturns (Ding *et al.*, 2016). For instance, according to survey data based on 2700 enterprises in China (World Bank Group, 2012, as cited by Fang & Xu, 2020), 62 per cent of enterprises were SMEs, of which 54.5 per cent required loans. Therefore, SMEs need loans to be able to sustain their businesses but have limited access to financing. For example, 38 per cent of the SMEs in Greece, 25 per cent in Spain, 24 per cent in Ireland and 21 per cent in Portugal considered access to finance as their most pressing problem (Fang & Xu, 2020).

Environmental sustainability is one of the most substantial challenges that manufacturing firms must tackle if they want to claim their legitimacy and build a strong reputation (Quintana-García *et al.*, 2019). In the face of the importance of green initiatives to build a strong brand, reduce cost and improve reputation and legitimacy, the return on investment remains uncleared for many firms. For firms to pursue green innovations, they need to see concrete and clear economic benefits as well as supportive governmental structures, which include incentive programmes, green training, among others. In the absence of financial gains and adequate incentive programmes, is it worth firms pursuing green innovation? Section 3.3.3 highlights the importance associated with the implementation of GSCM despite the cost involved. Vijayvargy *et al.* (2017) report that implementing GSCMPs provides long-term cost reduction, increase in profitability and productivity throughout the supply chain. This says somehow that all members of the supply chain networks may benefit from the implementation of green initiatives.

3.6 IMPORTANCE OF GREEN SUPPLY CHAIN MANAGEMENT IN THE MANUFACTURING SECTOR

The drivers of GSCM discussed in Section 3.4 provide some reasons behind the implementation of sustainable practices by companies, but there is also striking empirical evidence that stimulates its adoption. In the quest to increase their efficiency, effectiveness and competitiveness in the marketplace, companies around the world are turning to novel ways of doing business, which allow them to develop new processes and innovative techniques through the implementation of GSCM (Reche *et al.*, 2019). Embracing environmental initiatives enables manufacturing firms to build their brands and reputation that would enable them to sell their products and services at premium pricing (Shelman *et al.*, 2016). Furthermore, creating a reliable and trusted brand that is recognised as a unique and exceptional will foster customer loyalty and ultimately leads to an increase in market shares and profitability (*Ibid*). For example, the study conducted by The European Commission (2016), as cited by Cheung and To (2019) reveals that, in the European Union, 26 per cent of consumers purchase green products regularly while 54 per cent purchase green products sometimes. This demonstrates the conscious environmental attitude that customers have vis-a-vis green product which results in an increase in customer loyalty and market share. Building brand is echoed by Quintana-García *et al.* (2019), who stress that a strong reputation is built through positive initiatives such as green actions into the supply chain, excellent management of resources and capabilities and robust strategic and tactical planning that adds value to the business.

A study by Zaid *et al*. (2018) suggests that GSCM is not just a tool to minimise the impact of business activities on the environment but is also a strategy that brings along many other benefits for firms, which include improving the wellbeing of the populations, making economic gains, changing the cultural mindsets and fostering the business legitimacy through ethical behaviour. Similarly, Ahmed *et al.* (2018) argue that green practices provide valuable addition for firms as they help them achieve organisational targets such as improved market share and positioning, improved supply chain efficiency, waste reduction and cost-saving. Furthermore, Quintana-García *et al.* (2019) tested a set of hypotheses in a panel data of European manufacturing companies for ten years and found that strong support for the premise that supplier selection, monitoring and partnership termination based on environmental criteria positively influence corporate reputation. Additionally, their study suggests that the implementation of green strategies in an integral way as well as progressing towards the adoption of GSCM benefit a firm's reputation.

A study conducted by Green *et al.* (2019) aimed at investigating factors that contribute to organisational performance in the US manufacturing industry identified six improvement management programmes, which included GSCM to support strategic imperatives on customer focus, efficiency, effectiveness, integration and coordination of business processes with supply chain partners, responsiveness and environmental sustainability. Green *et al.* (2019) and Sellitto *et al.* (2019) further point out that GSCM contributes to firms’ ability to deliver to customers products that are environmentally friendly and that satisfy their evolving demands, thereby enhancing their reputation, market positioning and revenues. This demonstrates the importance of GSCM in achieving organisational performance through the supply chain and environmental returns.

A study by Vanalle *et al.* (2017) which explored GSCM pressures, practices and performance observed suppliers of a Brazilian automotive supply chain. The data of the study were treated using partial least squares structural equation modelling (PLS-SEM) provided by Smart-PLS software. The results indicate that the economic and environmental performance in the supply chain is positively related to the adoption and implementation of GSCMPs. Besides, the results provide managerial and theoretical perspectives for different industries in Brazil to focus on environmental awareness through GSCMPs. Finally, the study helps increase confidence among managers and policymakers of Brazilian companies concerning the adoption of GSCMPs as they exhibit superior performance improvements in the entire supply chain.

Based on the above studies, it is undeniable that the benefits of GSCM cannot be underestimated as it overweighs the challenges faced by manufacturing firms in the implementation of green initiatives. GSCMPs contribute to minimise the impact of business activities on the environment, reduce production costs, foster innovation and development for all sizes of organisations. Furthermore, GSCM is beneficial for all members of the supply chain as it helps achieve organisational objectives. It is important to stress that the supply chain concepts have been developed to mitigate the rapid deterioration of the planet, the rising temperature, among others and improving economic and social performance through the implementation of GSCMPs.

3.7 GREEN SUPPLY CHAIN MANAGEMENT PRACTICES

Green supply chain management practices are considered as actions aimed at reducing the impact of business operations on the environment, therefore bringing green value to the entire supply chain (Zaid *et al.*, 2018). Sellitto *et al.* (2019) assert that green practices are activities in the context of GSCM aimed at improving supply chain efficiency.

In literature, there have been numerous green practices used by scholars to address the concept of GSCM, all of which use different terminologies despite having a common aim which is to minimise and improve environmental performance. Zaid *et al.* (2018) classify green practices into two categories: internal (internal environmental management and eco-design) and external (environmental cooperation, green purchase and reverse logistics) green practices. Abdel-Baset *et al.* (2019) identified green practices as reverse logistics, green purchase, supplier environmental collaboration and carbon management while Quintana-García *et al.* (2019) focus on GSCM and define it as the monitoring of suppliers based on their environmental performance and their collaboration only with green suppliers that satisfy environmental standards.

The disparities in terminologies in describing green practices demonstrate how broad the spectrum of GSCMPs is, which let the study infer that there is a lack of consensus in developing a common framework for green practices. The study identified seven dimensions or practices of GSCM which included, GP; ED; GM; GD; RL; LR; and GT that helped to analyse, evaluate and control the performance indicators of the implementation of green practices (Figure 3.3). These seven dimensions of GSCM were selected for reasons that include the following: firstly, the importance of these dimensions has been discussed and demonstrated in literature for spreading green ideology in many organisations. Secondly, these dimensions address the critical role of green practices into the supply chain networks and their ability to reduce the impact of supply chain activities on the environment. Thirdly and lastly, these green practices have the potential to help firms develop strategic DCs that may enable them to achieve a supply chain performance resulting in sustainable competitive advantage. Figure 3.3 represents the GSCMPs selected for the present study. The section below provides the descriptions of each of the seven constructs of GSCM that became independent variables in the conceptual framework used for investigating the model.

Figure 3.3: Green supply chain management practices

Source: The author's own compilation.

3.7.1 Green purchasing

The term green purchasing refers to supply chain activities which incorporate environmental standards aimed at ensuring that products purchased have the lower impact on the environment and satisfy customer requirements (Song *et al.*, 2016; Younis *et al.*, 2016). GP also implies buying ecological materials without compromising the traditional procurement criteria set out by the buying firm in terms of quality, cost and delivery time (Vijayvargy *et al.*, 2017). GP activity has received more attention in recent years in literature as it ensures that both product-based and process-based procurements guarantee operational efficiency as well as customer satisfaction (Song *et al.*, 2016). Moreover, GP possesses additional characteristics that allow purchasing firms to build, develop and refine their internal competencies while considering market factors for an SCP (Yook *et al.*, 2017).

A number of authors suggest the buying firms can make use of different procurement strategies to select the appropriate suppliers, which consist of developing training programmes for suppliers, developing supply chain collaboration networks with suppliers and screening the supplier processes to ensure that they comply with the purchaser environmental requirements in terms of product quality, cost and timely delivery (Bai & Satir, 2020; Jazairy, 2020). Other purchasing strategies may include requiring suppliers to be certified in accordance with ISO 14000, which reduces or eliminates supply chain risks (Al-Sheyadi *et al*., 2019; Quintana-García *et al.*, 2019; Bai & Satir, 2020). Tseng *et al.* (2018) posit that the selection process of appropriate suppliers is crucial in addressing and curbing the adverse effects of supply chain activities on the environment; hence it is far-reaching for buying firms to ensure rigorous selection processes that will guarantee profitability. Jazairy (2020) proposes five steps to be followed before the acquisition of raw materials from suppliers, which include plan, select, implement, improve and partner. These steps ensure that the selection is meticulous, fair and will help meet and enhance the strategic objectives of the buying firms.

Moreover, Yook *et al.* (2017) stress that, in 2012, the cost of materials in the USA manufacturing sector represented 59 per cent of the total value of firms' revenue. This figure is significant and shows the key role that purchasing activities can play upstream the supply chain to save costs, improve efficiency, minimise wastes and promote long-term sustainable development. For example, Walmart implemented the "CO2 scorecard" and saved up to $3.4 billion through a reduction of packaging materials (Lefevre *et al.*, 2010, as cited by Yook *et al.,* 2017). A study by Younis *et al.* (2016) in the UAE manufacturing industry aimed at investigating the implementation of GSCMPs and their impact on corporate performance using statistical analyses based on the data collected through survey questionnaires from 117 firms, reveals that only GP plays a key role in improving the economic performance. GP activities in the supply chain can have a high impact on the firm's bottom line as they contribute towards building a positive image, reliable and reputable brand and goodwill in the market (Sreen *et al.*, 2017).

3.7.2 Eco-design

The issue of climate change has given strategic importance to ED practices in the fight to promote greener production as well as the commercialisation of new products (Jabbour *et al.*, 2015). Similarly, Marconi and Favi (2019) posit that scholars and practitioners have developed ED in response to sustainability issues and since then has been positively received within industrial sectors aiming to achieve cleaner production through product design and development. ED refers to the extent to which the firm's production activities cause minimum damage to the environment. The design process involves easy assembly and disassembly, remanufacturing or recycling and friendly disposal of products after their end-of-life cycle (Al-Sheyadi *et al.*, 2019). Simms *et al.* (2019) also suggest that ED stages include, product, process, marketing systems and organisational innovations. Jabbour *et al.* (2015) and Yi *et al.* (2020) also define ED as all dispositions undertaken by manufacturers to reduce and limit the impact of their operations on the environment during the product design phase.

Eco-design stage plays a vital role in determining the type and quality of the raw materials to be used, the energy consumption needed for the production and the waste monitoring and control systems. Beyond that, it allows firms to improve their operational efficiency and cost structure through material recovery and waste reduction during the designing process (Kulak *et al.*, 2015; Zaid *et al.*, 2018). For example, Yi *et al.* (2020) report that 80 per cent of the fixed environmental impact of a product life cycle is decided at the conception phase. This shows the important role that ED can play in defining designing and quantification methods, processes to be used to minimise environmental pollution as well as reduce costs. A study by Cicconi (2019) also demonstrates the importance of ED by focusing on the creative industry, which aims at increasing the understanding of practices and knowledge sharing about the use of recycled materials and found that ED activities through collaborative channels is the best tool to evaluate secondary raw materials, processes, user's feedback and best practices for the selection of green and recycled materials.

Technological development and innovation through ED represent a critical opportunity for sustainable development (Kulak *et al.*, 2015; Simms *et al.*, 2019). Simms *et al.* (2019) propose that ED represents a phase of production where opportunities to reduce the impact on environment exist and includes material usage per unit, energy usage per unit, carbon emissions, pollution (water, soil and noise), replacement of harmful materials and increased recyclability of output products. In additive manufacturing, for example, ED is considered as a technology of high resource efficiency and better ecological benefits and it used as a technique to minimise the adverse effects of manufacturing activities on the environment (Yi *et al.*, 2020). A study conducted by Costantini *et al.* (2016) aimed at highlighting the role of inter-sectoral linkages in shaping the influence played by innovative development on sustainability on sectoral environmental performance, revealed that both the direct and indirect effects of eco-innovations help reduce environmental pressures and that the strength of these impacts varies across the value chain depending on the technology adopted and the type of pollutant under scrutiny.

In their study, Civancik-Uslu *et al.* (2019) used a case study on packaging ED aligned with a circular economy strategy along the production chain. Life cycle assessment (LCA) was used to identify the product life cycle stages where the application of ED strategies would be more efficient (in this case, raw materials production from virgin petrochemicals). The study demonstrates that LCA combined with ED helps to achieve efficient environmental and economic savings. The findings are essential for the plastic packaging sector because they tackle prime concerns, like plastic debris, climate change and resource depletion.

3.7.3 Green manufacturing

Green manufacturing describes the process of producing goods or services that are in line with environmental requirements throughout the entire life cycle of the products while promoting the sustainability best practices (Hsu *et al.*, 2016). GM also refers to adopting processes and techniques that minimise the adverse effects of manufacturing operations such as scrap and wastes on the environment (Seth *et al.*, 2018; Pang & Zhang, 2019). In the broader sense, the study suggests that GM implies the manufacturing of products with the precise aim of saving resources and minimising wastes of all nature. Numerous studies have addressed the evolution and growing popularity of GM among scholars and practitioners since the 1990s as a strategic tool that represents the frontier for the fight against environmental pollution, which fosters the quest for sustainable manufacturing through waste minimisation and resource-saving (Pang & Zhang, 2019; Wang & Feng, 2019; Agarwal *et al.*, 2020).

A study by Singh *et al.* (2020) suggests that GM practice is the result of new dynamics in the marketplace, such as technological development and innovation, intensification of the competitiveness level and the ever-changing needs of customers with regard to environmentally friendly products. It is further stressed that these new dynamics gave rise to new opportunities that can be grasped by manufacturing firms through GM technology, knowledge acquisition to extend their footprint (*Ibid*). The intensification of green competitiveness has become an important instrument to evaluate the competitiveness of the manufacturing sector. Consequently, manufacturing firms are required to develop new techniques and strategies that will allow them to improve the efficiency of their processes while promoting a cleaner environment (Wang & Feng, 2019). Pang and Zhang (2019) alluded that GM does not only promote the respect of environmental requirements, but also brings along other benefits, which include reduction of cost of disposal, employee protection, health and risk management.

A study by Seth *et al.* (2018) in the Indian manufacturing context targeting SMEs and large firms using an interpretive structural modelling approach, reveals that GM provides better financial gains and better reputation through a cleaner ecosystem if the implementation is performed adequately. The study suggests that GM consists of processes which include product design, selection of raw materials and packaging that comply with environment norms, manufacturing, distribution and recycling after the end-of-life of products. Mao *et al.* (2019) postulated that GM requires stringent environment requirements as its centre of interest directly targets high-level efficiency and safety. Moreover, GM technique can be realised through three main objectives, which include lessening the energy consumption and wastes, managing risk and process control and environmental management (*Ibid*). These management objectives would help firms bring about the advert effects of manufacturing activities on both public health and environmental safety due to long-term pollution effects (*Ibid*).

3.7.4 Green distribution

Green distribution refers to as supply chain activities aimed at reducing or eliminating the adverse effects of operations on the environment during the shipment process. These activities include fuel consumption during transportation, frequency of transportation activities and travelled distances (Çankaya & Sezen, 2019). GD plays a vital role in the supply chain networks, which consist of fostering cooperation and collaboration among members, encouraging firms to embrace the path towards a technological development as well as achieving sustainable goals (Centobelli *et al.*, 2020). GD also contributes to stimulating technological transformation as it represents a great step towards achieving innovation for sustainable development (*Ibid*). Moreover, GD contributes towards decreasing environmental impact, resulting from transportation fleets' networks and improving the supply chain efficiency in terms of energy consumption and environmental damages (Ji *et al.*, 2015).

An increase in customer demands, as well as high levels of production operations, have led to the surge of more transportation activities. The importance of GD has been demonstrated in literature for curbing the adverse impact of supply chain activities such as transportation on the environment (Mohtashami *et al.*, 2019). Transportation activities in the supply chain have been linked to increasing the supply chain cost and greenhouse gas through carbon dioxide emissions (Memari *et al.*, 2015; Mohtashami *et al.*, 2019). Consequently, Memari *et al.* (2015) developed an economic model perspective using Just-in-time (JIT) logistics that provided a balanced outcome among transportation frequency, total costs as well as environmental impact. The study revealed that the reduction in the amount of carbon emissions leads to reduced costs because the environmental-based objective function tends to use less air polluted distribution. The cost-based objective function offered an optimum number of transportation trips, which also give a positive environmental impact.

Similarly, a study by Mohammed and Wang (2016) investigated a three-echelon meat supply chain by developing a fuzzy multi-objective programming model incorporating uncertainties. The model aimed at optimising four objectives, which include: minimising the total transportation and implementation cost; minimising the number of carbon emissions; the distribution time of products from farms to abattoirs and from abattoirs to retailers; and maximising the average delivery rate that satisfies product quantity as per the request of abattoirs and retailers. To optimise the four objectives simultaneously, three solution methods were investigated and used, which include the LP-metrics method, the ε-constraint method and the goal programming method. The best solution was determined using the Max-Min method by comparing the obtained Pareto solutions. The study shows GD decreases in transportation and implementation costs, fuel consumption, the effect on the environment, distribution time as a result of choosing the optimum number of locations that should be opened in response to the quantity flow of products to obtain a trade-off among the considered objectives.

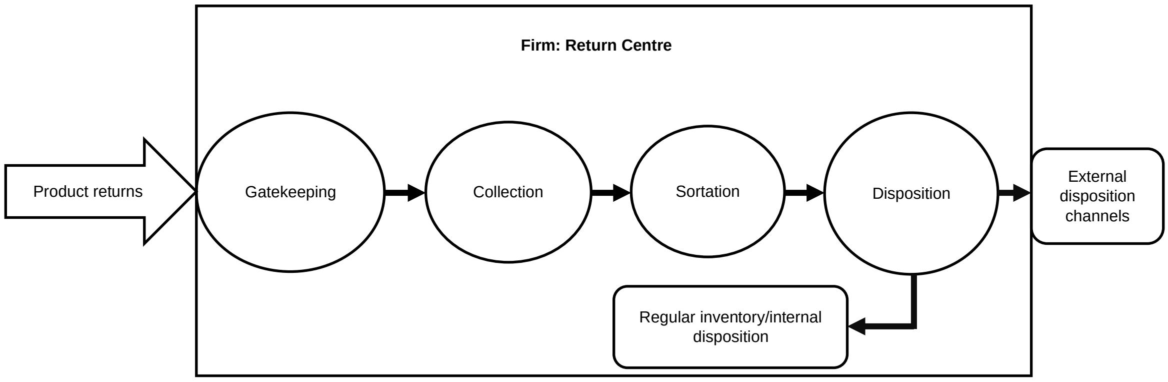
3.7.5 Reverse logistics

The theory of circular economy suggests that waste represents resources that are not properly used, which possesses more than a residual value that can be explored, extracted and exploited through adequate mechanisms such as RL to create new value to products, minimise the impact on the environment and improve the efficiency of the supply chain (De Oliveira *et al.*, 2019; Guarnieri *et al.*, 2019). RL activities can be defined as a process of recycling, repossessing, remanufacturing, or disposing of products collected from consumers in a safe and friendly manner (Hsu *et al.*, 2016; Gu *et al*., 2019). RL also describes the process of collecting used or end-of-life products from consumers to the point of origin to recapture value or proper disposal (Reddy *et al.*, 2019; Azizi *et al.*, 2020).

The role RL plays in contributing for a cleaner environment and effective utilisation of resources has been recognised globally as a result of environmental concerns, government regulations and policies, business sustainability, single global market, warranty returns and product's end-of-life (Prajapati *et al.*, Kant & Shankar 2019). Hsu *et al.* (2016) further stress that RL strategy helps firms to extract value from used and returned products as well as quantify the effectiveness and the efficiency of their supply chain operations. Similarly, Abdel-Baset *et al.* (2019) argue that used material inflows are valuable assets for RL strategy as they represent an opportunity for supply chain members to make sound improvements to the networks through assessment of performance indicators.

Product returns happen for several reasons, which include damage of products, defects in products, upgrade version of products available, or discontentment for products not meeting customers' expectations, among others. Returned products are processed by firms in a way that ensures the effectiveness and efficiency of the process (Agrawal & Singh, 2019). Reddy *et al.* (2019) allude that the RL process involves creating inspection and remanufacturing centre, managing centre throughput to satisfy demands, choosing between storing and inventory or purchasing new products or disposing of returned products. Similarly, a study by Gu *et al*. (2019) stipules that RL operations include collection, sortation, processing and recycling, which is similar with Sanni *et al.* (2019) model in Figure 3.4 adopted in the current study. Moreover, Gu *et al.* (2019) stress that the significance of RL resides in its ability to improve resource utilisation, energy consumption, promote a cleaner environment, reduce cost and enhance the manufacturer's reputation. Hammes *et al.* (2019) posit that proper management of RL processes is necessary due to their contribution to the development and improvement of the supply chain in terms of cost reduction, revenue increase and customers' satisfaction.

Figure 3.4 Reverse Logistics process at a firm-level



Source: Adapted from Sanni et al. (2019).

Figure 3.4 illustrates RL process at a firm-level where returned products are subjected to multiple inspections and processing stages at the return centre, which includes gatekeeping, collection, sortation and the returned products which ultimately arrive at the disposition state, which can be either internal or external to the firm. All important decisions are made at the disposition stage, which plays a crucial role in ensuring the operational efficiency of the process. At the deposition stage, returned products are evaluated and decisions are taken regarding their reuse, upgrading, retrieval or safe and friendly disposal. Similarly, a study by Agrawal and Singh (2019) suggests that the traditional disposition stage comprises three options, which include product reuse, product recovery and waste management. The study further asserts that these traditional options were revised to include product reuse, product upgrade, material retrieval and waste management. It is important to note that all these stages contribute towards ensuring effective management of the process, extracting value to returned products that manage waste and foster operational efficiency of the process.

In contrast, a study by Sanni *et al.* (2019) suggests that investment cost on RL programmes are too high and augment exponentially with the increased rate of product returns. The authors stress that product returns reduce the profitability of retailers by 4.3 per cent and postulate that in this context, gains come in the form of customer satisfaction, decreased inventory levels and reduced cost. To find an optimum solution to the reverse flow of products to the regular inventory system, the study developed an EOQ (economic order quantity) model with an RL strategy and found that by optimising the RL processes, businesses can experience long-term benefits and reduce revenue spent on product returns.

3.7.6 Legislation and regulations

The influence of LR on firms to adopt and implement GSCM can be interpreted as institutional theory, discussed in section 3.2.1. This suggests that the theory represents external factors that legally compel firms to align their strategies with environmental requirements (Agarwal *et al.*, Li 2018). According to Vanpoucke *et al.* (2016), regulatory institutions include governments, trade associations, informal networks and other stakeholders that can induce governments and companies to adopt and implement green technology to reduce costs and minimise wastes.

Legislation and regulations can be defined as policies and programmes developed by governments and other institutional bodies to ensure compliance by business actors with environmental requirements (Huang *et al.*, 2015). Sayed *et al*. (2017) also describe legislation and regulatory practices as a legally binding framework that guides and promotes the implementation of green activities, which result in recognition of the legitimacy of firms to operate. From the LR perspective, governments and regulatory bodies can have a high impact on firm's strategic decisions by compelling them to align their strategies with environmental regulations and policies or face legal actions (Huang *et al.*, 2017; De Oliveira *et al.*, 2019).

Legislation and regulations play an essential role in shaping the implementation of GSCM across the manufacturing sector as well as other sectors of the economy (Singh *et al.*, 2020). In a similar context, Jerónimo *et al.* (2019) also suggest that regulatory practices contribute towards compelling firms to adopt green strategies in the wake of environmental issues, hoping that the implementation of green practices would improve their social, economic and environmental performance. LR practices stimulate a general sense of awareness across all sectors of the economy about the harmful effects of business operations on the environment by persuading companies to embrace cost reduction and waste management strategies through the implementation of GSCMP (Ghosh, 2019).

The embracing of technological innovation such as GSCM requires substantial investments in terms of human capital, training, research and development, equipment among others, hence the importance of incentive programmes developed by governments to support businesses in their endeavour towards achieving simultaneously environmental sustainability and economic performance (Singh *et al.*, 2020). Huang *et al.* (2017) suggest that the involvement of governments in promoting sustainability can help remove obstacles that hinder and prevent firms from pursuing green initiatives.

Legislation and regulations are viewed by Tachizawa *et al.* (2015) as an adaptative mechanism that does not promote self-determination and proactive resolve, but rather a reactive character from manufacturing firms in matters regarding environmental sustainability. In a similar context, Vanpoucke *et al.* (2016) argue that firms mostly take a more passive approach when their main objectives become meeting mandatory requirements and not exceeding them. This implies that firms will just be concerned about the consequences (fines or penalties) of non-compliance. For example, when firms are afraid of the result of non-compliance, they only engage in those green activities that are mandatory.

Several studies have provided empirical evidence of regulatory pressures contributing towards encouraging the adoption and implementation of GSCM (Huang *et al.*, 2017; Kauppi & Hannibal, 2017; Micheli *et al.*, 2020). For example, based on IT, Zeng *et al.* (2016) constructed a concept model according to the paradigm of institution-conduct-performance. Zeng *et al*. (2016) then tested the mechanism and relationships among institutional pressures, supply chain relationship management, sustainable supply chain design and circular economy capability using data collected from eco-industrial park firms in China via 363 questionnaires. The findings show that institutional pressure through LR has a significant positive impact on supply chain relationship management and sustainable supply chain design; sustainable supply chain management practice is an important factor promoting the improvement of the circular economy capability of companies.

In contrast, a number of studies suggest that LR practices do not lead to the adoption and implementation of GSCM (Agarwal *et al.*, 2018; Li *et al.*, 2019). For example, a recent study by Agarwal *et al.* (2018) proposed a model of GSCM adoption in which pressures from markets and suppliers are mediated by internal impetus while regulatory burdens impact adoption directly. The model was tested with a sample of 60 manufacturing companies in the U.S. Midwest region using the Partial Least

Squares (PLS) technique and the findings reveal that LR pressures have no impact on GSCM adoption for companies considered in their study. As a consequence, Blok *et al.* (2015), as cited by Tumpa *et al.* (2019), recommend that governments should instead focus on developing incentive programmes that encourage and support firms to adopt and implement GSCMPs. Furthermore, incentive programmes would help fund and train businesses that do not have the resources required to pursue green activities since the evidence shows that government policies that provide incentive programmes to implement green initiatives have a significant impact on top management championship (Li *et al.*, 2019). Tumpa *et al.* (2019) also suggest that governments must negotiate with industry professionals to find the appropriate way of dealing with environmental issues and help them achieve environmental sustainability as well as economic performance. Vanpoucke *et al.* (2016) also report that the legislation must provide some sort of flexibility and mobility to firms because green activities represent a burden and are very costly to implement.

3.7.7 Green training

Green training can be described as a process of on-the-job training and continuous development of knowledge and skills acquisition aimed at achieving a cleaner environmental performance (Teixeira *et al*., 2015; Pinzone *et al*., 2019). Xie *et al*. (2020) also define GT as skills development in green initiatives that allow employees to participate effectively in the battle against the pollution of the environment. GT has received the attention of academics and practitioners seeking to develop comprehensive training programmes that provide significant and valuable outcomes for employees with the prime focus on promoting firm values and interests in pollution matters (Cabral & Dhar, 2019; Xie *et al.*, 2020). GT programmes allow personnel such as upper management, middle management and workforce to integrate the firm's performance on environmental issues (Teixeira *et al.*, 2015).

Green training is considered as a powerful tool to achieve environmental sustainability through employee's skills development (Jerónimo *et al.*, 2019; Liu *et al.*, 2019). Furthermore, the authors allude that GT helps enhance employees' rational perception towards their organisations in sustainability matters. Jerónimo *et al.* (2019) and Pham *et al.* (2019) further stress that GT plays a crucial role in providing employees with information regarding the position of the firm in matters of pollution, generating environmental awareness and empowering employees to identify and tackle environmental issues. Companies need to train employees to participate and champion environmental concerns, communicate mechanisms in which they can become part the environmental management programme and empower them to understand their responsibilities and make sound decisions on behalf of the organisation. Managers should develop training programmes that do not consider rewards as a motivational tool to pursue green battles (Jerónimo *et al.* 2019).

The importance of GT is acknowledged by Pinzone *et al.* (2019) who stress that the programme raises awareness on how daily activities of firms affect the environment, seen from the employees' perspective that helps them identify environmental issues and how to discharge their duties on those identified concerns and how to promote championship status on sustainability issues. Cabral and Dhar (2019) posit that GT programmes are systematic processes that disseminate green knowledge to employees since green experience represents a vital element that helps build a culture of sustainable practices within an organisation. Pinzone *et al.* (2019) demonstrated this perspective, based on a survey of 260 Italian healthcare professionals, which suggests that GT provides employees with specific green knowledge and competencies to enforce their commitment to green initiatives and increase their work satisfaction. Moreover, GT allows employees to turn challenges from the external environment into opportunities to promote waste management, energy efficiency and in turn, empower local communities (Cabral & Dhar, 2019).

Green training programmes provide a golden opportunity to professionals to learn about new knowledge, develop and enhance their skills in emerging practices such as GT for the implementation of best management practices (Johnson *et al.*, 2019). GT also builds employees' expertise, helps them to speak the green culture language and promote the widespread sustainability, all of which result in a high level of motivation and commitment as well as career's growth (*Ibid*). A study by Xie *et al.* (2020) used a dual-stage moderated mediation model to analyse whether, how and when GT contributes to promoting employees' career growth. The results reveal that GT is positively related to employee career growth. The study also shows that employee performance mediates the relationship between GT and career growth.

A study by Bowen *et al*. (2018), in which they estimate that the share of jobs in the US would benefit from a transition to the green economy, contrasts the significance and importance of GT by arguing that on-the-job training limits the flexibility of the workforce and affects its transitional path towards a green economy. On-the-job training develops and builds a specialised workforce that requires high cost and lengthy periods of re-training to integrate the new economic system. Consequently, the dedicated workforce is likely to create higher and persistent unemployment as it does not respond well to economic changes that can occur as a result of economic downturns or structural change.

3.7.8 Green practices' summary

Environmental sustainability and technological development are essential requirements needed to compete in the dynamic global market where the life span of technology is becoming shorter and shorter and consumers' behaviours and demands more complex and sophisticated. Green activities stimulate consumers' awareness of environmental concerns and foster market penetration as well as share expansion for green-labelled products (Cai *et al.*, 2017). Furthermore, green-labelled products represent a marketing tool that can be used by firms to convey environmentally friendly characteristics of products to consumers, thus enhancing their market share. It is important to stress that one-size-fit-all does not apply to GSCM as the technique possesses a panoply of green initiatives. Manufacturing companies must choose the green practices that fit their vision and strategy as well as their organisational structure (Zhu *et al.*, 2019). However, the green practices discussed in the study represent guidance or pathway to sustainable development for firms willing to adopt and implement GSCM.

3.8 RESEARCH GAP ANALYSIS

This section provides a brief description of the few previous studies on GSCM conducted in the manufacturing sector across the globe and in South Africa in particular. They have been selected because of their relevance to demonstrate that although similar studies have been done before in the field of GSCM, some substantial differences and gaps still exist, thereby providing an impetus to the present study. Tables 3.1 and 3.2 highlight the selected studies and provide brief analyses before providing the reason and motivation attached to the present study.

3.8.1 Previous Research Studies on GSCM in the manufacturing sector on the international context

Table 3.1 provides a listing of few studies conducted on green supply chain management in the manufacturing sector in the international sphere, followed by a brief description and research findings as well as the researcher's observation.

Table 3.1 International studies on green supply chain management in the manufacturing sector

Authors	Year of Publication	Type of industry	Objective	Finding	Methodology	Theory employed	Area of interest
Namagembe *et al.*	2018	Manufacturing SMEs in Uganda	The study investigates the relationship between EO and green supply chain practice adoption.	Enviropreneurial orientation positively influences green supply chain practice adoption.	Quantitative method/ Cross-sectional survey design & structural equation modelling	Theory of Reasoned Action	Green supply chain management
Seth *et al.*	2018	Manufacturing sector in India	To prioritize and compares GM drivers for both SMEs and large industries	GM drivers and allied issues play a key role in strategic manufacturing decisions	Interpretive structural modelling (ISM) approach (Qualitative approach)	The study was not grounded on a theory	Green manufacturing
Tan *et al.*	2018	Manufacturing sector in Malaysia	To examine the influence of green supply chain management practices (GSCMP) and manufacturing capabilities on organizational performances	The study found that internal environment management, inventory recovery and eco-deign had ignificantly and positively on manufacturing capabilities, whereas supplier-customer collaboration had no significant with manufacturing capabilities	A quantitative method was used with the data obtained from the sample of 103 large manufacturing firms	Resource based view (RBV) theory	Green supply chain management
Quintana-García *et al.*	2019	European manufacturing sector	The impact of strategies oriented to green supply chain management on a firm's corporate reputation	Supplier selection, monitoring and partnership termination based on environmental criteria positively influence corporate reputation	Quantitative approach	Theory of collective reputations	Green supply chain management

Source: Author's own compilation.

The present study identified a few studies which include components of green supply chain management in the manufacturing sector. The first study in Table 3.1 is by Namagembe *et al.* (2018), whose purpose was to assess the relationship between five green practices and firm performance. In addition, it investigated the influence of each green practice on environmental performance, economic benefits and economic costs. The findings reveal that different green practices affect different performance dimensions in different ways across various industries. For example, ED and internal environmental management practices significantly influence environmental performance; GP and internal environmental management practices significantly influence economic benefits and internal environmental management practices affect economic costs. Overall, internal environmental management is the key to positive outcomes across the three performance criteria. The study shows how the results obtained vary from similar studies conducted in developing countries and explain possible reasons for the difference.

The second study in Table 3.1 by Seth *et al.* (2018), conducted in the Indian manufacturing sector had the purpose of answering two questions; (1) are GM and its drivers in SMEs different from large companies? (2) how do these drivers influence GM? The study also develops and compares GM models for both, based on the identified GM drivers using the interpretive structural modelling (ISM) approach, covering compliance to green standards/legislations, financial incentives, management commitment and support, marketing and other associated green drivers. The research enhances the understanding of the mutual influence of green drivers. It also guides the identification of the right set of drivers by utilising the driving and dependency power to influence GM, for both. Thus, the study addresses the needs of both sectors and facilitates researchers and practitioners to effectively utilise the appropriate set of green drivers in strategically leveraging GM.

The third study in Table 3.1 by Tan *et al.* (2018) aimed to examine the influence of GSCMPs and manufacturing capabilities on organisational performances. A quantitative method was used with the data obtained from the sample of 103 large manufacturing firms listed in the Federation of Malaysia Manufacturers (FMM). Smart-PLS 3.0 software was employed to confirm data validity and reliability and tested the structural path modelling. This implied that GSCMPs, with manufacturing capabilities as the mediator, is important to foster organisational performance among manufacturing firms. A total of 103 manufacturing companies in Malaysia participated in the study with a response rate of 18 per cent. It shows that only eight sub-hypotheses out of thirteen sub-hypotheses were supported and the remaining five sub-hypotheses were not supported. The findings provide theoretical and practical implications as well as suggestions for future studies in different industries.

The fourth and final study in Table 3.1 by Quintana-García *et al.* (2019) aimed at gaining further knowledge regarding the impact of strategies oriented to GSCM on a firm's corporate reputation. The study tests a set of hypotheses in a panel data of European manufacturing companies for a period of ten years. The findings provide strong support for the premise that supplier selection, monitoring and partnership termination based on environmental criteria positively influence corporate reputation. Additionally, evidence suggests that the implementation of those strategies in an integral way as well as progressing towards the adoption of GSCM benefit a firm's reputation.

Interesting research has been conducted on GSCM (Lee, 2015; Kirchoff *et al.*, 2016; Younis *et al.*, 2016; Liu *et al.*, 2018; Tseng *et al.*, 2018). For example, Sharma *et al.* (2016) explored diverse performance indicators which are responsible for GSCM implementation. Vanalle *et al.* (2017) explored the association between GSCMPs, environmental and economic performances. Abdel-Baset *et al.* (2019) formulated a neutrosophic approach to evaluate the relationship between GSCM, economic and environmental performances. Quintana-García *et al*, (2019) used stakeholder approach and environmental management capability framework to show the impact of GSCM on corporate reputation. Some studies have shown the relationship between GSCM and SCDC. For example, Essid and Berland (2018) used a DC approach to analyse organisational capabilities involved in the adoption of GSCMPs. Gruchmann and Seuring (2018) used DCs to assess the performance of logistics in social responsibility practices. Other studies have demonstrated the relationship between DCs and organisational performance. For example, a study by Hasegan *et al*. (2018) explored how the resources can be developed and maintained into DCs to sustain competitive advantage. Sharma and Martin (2018) developed a model based on product innovation capabilities as DCs to help understand the effect of DCs on the firm's performance.

An analysis of the above studies, as well as those listed in Table 3.1, demonstrates that previous studies have mainly focussed on environmental and organisational performances through the implementation of GSCM. Some studies have provided empirical validation of the relationships between GSCM and SCDC and others between SCDC and SCP. Neither of these studies has provided empirical evidence of the relationship between GSCM, SCDC and SCP. This shows that there is still a dearth of literature that links GSCM with SCDC and SCP. Thus, there is a need for further research studies based on empirical surveys to provide more insights into how GSCM and SCDC interact to produce a higher SCP.

3.8.2 South African context

Table 3.2 provides a listing of seven studies conducted in the South African manufacturing sector on GCSM followed by their descriptions and research findings as well as the researcher's observation.

Table 3.2: Supply chain management studies in the manufacturing sector in South Africa

Authors	Year of Publication	Type of industry	Objective	Finding	Methodology	Theory employed	Area of interest
Mund *et al*.	2015	Automotive	To explore the extent to which principles of lean product development are applied to product design and engineering at automotive companies in South Africa (SA).	The study established that while SA automotive companies have a strong manufacturin g. focus there is very limited local product design and development (PD&D), as this tends to be carried out centrally for multinational s	Mixed methods using A questionnaire based on the Toyota's lean product development system (LPDS), and follow-up interviews were used to ascertain the extent to which lean principles informed product engineering and identify areas where there was scope for improvement.	The study was not grounded on a theory	Lean product engineering
Mafini & Muposhi	2017	SMEs in Manufacturi ng	To examine the association between green supply chain management (GSCM) practices, environment al collaboration and financial	The study shows that three GSCM practices, namely, green procurement green logistics and green manufacturin g in SMEs exert a	Quantitative in nature and involves a convenient sample of 312 SMEs based in Gauteng Province, South Africa	The study was not grounded on a theory	Green supply chain management in small to medium enterprises

Authors	Year of Publication	Type of industry	Objective	Finding	Methodology	Theory employed	Area of interest
			performance in SMEs.	positive effect on environmental collaboration, with green manufacturing exerting a higher effect than the other two constructs. In turn, higher levels of environmental collaboration inspired higher levels of SME financial performance.			
Bag *et al.*	2018	Manufacturing	To investigate the function of remanufacturing capability in influencing supply chain resilience in supply chain networks under the moderating effects of both flexible orientation and control orientation	Market factors, management factors and technical factors positively influence dynamic remanufacturing capability (DRC).	Quantitative using Data were gathered through a survey	Dynamic capability view (DCV)	Dynamic remanufacturing capability on supply chain resilience in circular economy
Bag *et al.*	2018	Manufacturing	To examine the influence of organization culture (OC), green supplier development (GSD), supplier relationship management, flexibility and innovation on sustainability in supply network (SSN) under the moderation effect of institutional pressures and resources availability	OC plays a crucial role in shaping the workforce behavior and responsible for enhancing GSDs and building good relationship with suppliers which ultimately results into increased flexibility and innovativeness. Coercive pressures (CPs) play a moderating role between the causal relationship of innovation and SSN	Quantitative approach / survey data gathered from 175 respondents in the KwaZulu-Natal province of Southern Africa using structural equation modeling	Integrating institutional theory (IT) and resource-based view (RBV) theory	Innovation and flexibility in configuring supply network sustainability

Authors	Year of Publication	Type of industry	Objective	Finding	Methodology	Theory employed	Area of interest
Epoh & Mafini	2018	SMEs in the Manufacturing	To analyse the relationship between green supply chain management environmental performance and supply chain performance in South African SMEs	The results of the study indicated mixed outcomes. No relationships were found between environmental performance and two green supply chain dimensions, namely green purchasing and eco-design. However, the remaining dimensions of green supply chain management, namely reverse logistics and legislation and regulation, positively and significantly predicted environmental performance. In turn, environmental performance positively and significantly predicted supply chain performance.	Quantitative approach using data collected from SMEs based in Gauteng province	The study was not grounded on a theory	Green supply chain management in small and medium enterprises
Muganyi *et al.*	2018	Chemical manufacturing	To unveil the practical use of Lean Six Sigma and its effectiveness as a business survival strategic tool by a chemical product realization concern, as well as to establish the market and business performance impacts on	The research findings were mainly based on the inferences obtained from a chemical product manufacturing concern in South Africa, to distinguish the efficacy and relevance of Lean Six Sigma as strategic	A case study approach was used.	The study was not grounded on a theory	Lean six sigma in the chemical manufacturing industry

Authors	Year of Publication	Type of industry	Objective	Finding	Methodology	Theory employed	Area of interest
			the manufacturing entity.	business survival tool and imputing strategic resonance to corporate strategy.			
Niehaus *et al.*	2018	Manufacturing, retail and services	To investigate the current sustainability reporting practices in supply chains of SA organisations	The results showed that there is insufficient data for some of the sectors; however, there are differences in the supply chain and sustainability practices for the remaining sectors. There are also differences in these practices between SRI and non-SRI companies	Qualitative / The research for this article was conducted using secondary. research methods	The study was not grounded on a theory	Supply chain sustainability in South African organisations

Source: Author's own compilation.

Table 3.2 identifies seven studies which include some components of GSCM within the manufacturing sector in South Africa. The first study by Mund *et al.* (2015) explored the extent to which principles of lean product development are applied to product design and engineering at automotive companies in South Africa (SA). The survey establishes that while SA automotive companies have a strong manufacturing focus, there is very limited local product design and development, as this tends to be carried out centrally for multinationals. However, the global product designs require modifications to suit local conditions and many decisions about manufacturability are taken locally. The study finds considerable scope for increasing the extent to which aspects of product engineering were influenced by lean thinking.

A study by Mafini and Muposhi (2017) examined the association between GSCMPs, environmental collaboration and financial performance in SMEs in the manufacturing. It shows that three GSCMPs, namely green procurement, green logistics and GM in SMEs exert a positive effect on environmental collaboration, with GM using a higher impact than the other two constructs. In turn, higher levels of environmental collaboration inspire higher levels of SME financial performance.

The world is facing increasing immense pressures of resource scarcities. More and more manufacturing firms are embracing the circular economy (CE), which is a system characterised by the application of remanufacturing principles and adoption of sustainable manufacturing practices. Bag *et al.* (2018), in their study, investigated the function of remanufacturing capability in influencing supply chain resilience in supply chain networks under the moderating effects of both flexible orientation and control orientation. The results indicate that market factors, management factors and technical factors positively influence dynamic remanufacturing capability (DRC). More specifically, on the one hand, market factors strongly influence DRC, whereas, on the other hand, both management and technical factors influence at lower-level DRC. Dynamic remanufacturing capability has a positive influence on supply chain resilience. Flexible orientation is found to positively moderate the effect of DRC on supply chain resilience, whereas control orientation does not exert any moderating effect on DRC and supply chain resilience.

A study by Bag *et al.* (2018) examined the influence of organisational culture, green supplier development, supplier relationship management, flexibility and innovation on sustainability in the supply network of South African manufacturing firms under the moderation effect of institutional pressures and resources availability. The study reveals that organisational culture plays an important role in shaping workforce behaviour and is responsible for improving the green supplier development and building a good relationship with suppliers. It finds that a good relationship with suppliers ultimately results in improved flexibility and innovation. It also reveals that governmental and other institutional pressures play a moderating role between the causal relationship of innovation and sustainability in the supply network. The study concludes that coercive forces can amplify or reverse the effect between innovation and sustainability in the supply networks.

A study by Epoh and Mafini (2018) analysed the relationship between GSCM, environmental performance and SCP in South African SMEs in the manufacturing sector. The results indicate mixed outcomes. No relationships were found between environmental performance and two green supply chain dimensions, namely green purchasing and eco-design. However, the remaining dimensions of GSCM such as RL and LR, positively and significantly predicted environmental performance. In turn, environmental performance positively and significantly predicted SCP. The study concludes that integrating GSCMPs, especially RL and adherence to LR into the SME business strategy, leads to the improvement of environmental and overall SCP.

A study conducted by Muganyi *et al.* (2018) aimed at unveiling the practical use of Lean Six Sigma (LSS) and its effectiveness as a business survival strategic tool by a chemical product realisation concern, as well as to establish the market and business performance impacts on the manufacturing entity. The research study confirms that Lean Six Sigma is an effective business survival and market performance enhancement strategic tool that can be used effectively by any organisation to attain business survival and enhanced performance in the marketplace. The study shows that it was proven with the justifications above that LSS could be a panacea for organisational survival, business and product market performance, as it helps to reduce costs, improve quality, reduce wastes, impart strategic competitive advantage, aids in attaining GM status and improving employee skills and involvement in decision making.

A study by Niehaus *et al.* (2018) investigated the sustainability reporting practices in supply chains of South African organisations, which include manufacturing companies. The focus was specifically on the supply chain sustainability practices of organisations listed in selected sectors on the Johannesburg Stock Exchange (JSE). A secondary objective was to investigate the preparation efforts by SA companies for the impending carbon tax. The results show that there is insufficient data for some of the sectors; however, there are differences in the supply chain and sustainability practices for the remaining sectors. The research also shows that companies are discussing important concepts relating to the implementation of the impending carbon tax.

A close evaluation of these previous studies conducted in the South African context shows that most studies have focussed on the impact of GSCM/Lean six sigma on environmental performance and SCP. This demonstrates that studies on GSCM and their effect on SCDC, which in turn leads to SCP, are still under-researched (Epoh & Mafini, 2018), suggesting that less is known about the relationship GSCM, SCDC and SCP in developing countries such as South Africa. This low level of implementation of GSCM requires that more research be conducted to enable SCM professionals to develop strategies suitable for their companies and for scholars to understand and communicate to others the benefits associated with the adoption and implementation of sustainable supply chain practices. Furthermore, although evidence suggests that the concepts of GSCM practices lead to higher SCDC and superior SCP (e.g., Kirchoff *et al.* 2016; Younis *et al.*, 2016; Famiyeh *et al.*, 2018), there is still a dearth in literature in South Africa with regard to the adoption and the implementation of GSCM to achieve sustainable development.

Despite the significant influence GSCMPs may have on the firm's performance, few studies have focussed specifically on exploring the relationships between GSCMPs, SCDC and SCP (Yu & Ramanathan, 2016: Kähkönen *et al.*, 2018). Unlike other attempts, the present study provides a different shade to the existing literature by focusing on modelling a relationship between GSCM, SCDC and SCP in the South African manufacturing sector. Therefore, it proposes a model that incorporates seven GSCMPs and assesses their combined impact on SCDC, which in turn leads to higher SCP through SCA, SCREL, SCC, SCR, SCQ and SCB. The present study adds the body of knowledge based on its implications for practitioners and scholars, as well as its ability to help decrease the adverse effects of business activities on the environment.

3.9 AUTHOR'S IDEAS AND ANALYSIS

This chapter discussed three theories which include institutional theory, dynamic capability theory and contingency theory. These theories demonstrate the essential role in promoting the adoption and implementation of GSCM. Institutional theory is characterised by its ability to provide guidelines to manufacturing firms. It mainly focuses on explaining isomorphism of manufacturing firms pertaining to institutional norms. Following these guidelines may certainly grant legitimacy to operate in the society and also help gain some form of knowledge. This somehow explains why manufacturing firms need to develop strategic relationships with all their stakeholders since it is believed that they are all acting in a rational and predictable manner. However, institutional theory might not always deliver on efficiency or be the solution to all supply chain management issues which includes providing expertise and financial support. In this context, companies may use illegal means just for the sake of being seen as legitimate entities. This view is also supported by Mohamed, (2017) who suggests that organisations may acquire and promote a formal structural form that doesn't even increase efficiency just for the sake of legitimacy. Companies may and introduce or adopt specific vocabularies of their structure like designations, procedural names, and employees' roles because they also provide legitimacy. However, a study by Younis and Sundarakani (2019) shown that institutional theory represents the motivation behind the adoption and implementation of GSCM by firms. This motivation not only provides efficiency but rather the desire to achieve social legitimacy and business sustainability.

Dynamic capability theory advocates for the need to build, adapt, refine and reconfigure their strategies to absorb the effects of constant changes in a business environment (Teece, 2017). This definition comes from Teece who is one of the seminal authors in the field of supply chain management. The definition seems too broad; this could be the plausible reason why dynamic capability possesses various definitions making it difficult to reach a consensus. In addition, throughout the literature review, dynamic capabilities demonstrate mixed outcomes in terms of organisational performance. Teece definition, while providing a start, left open to questions of what effectively constitutes such abilities, what their attributes are, how they can be recognised, and where they come from. The slowness in convergence on a common definition may be due as well to variations within the community that contributed to the development of this concept. Scholars coming from different research traditions have viewed dynamic capabilities with different lenses, reflecting their different backgrounds. However, dynamic capability theory is wide used in the field of supply chain management and its ability to shape company resources and strategies was demonstrated throughout this study.

Contingency theory advocates that in times of uncertainty and economic turbulences, firms must embrace the best practices that can enable them to find the appropriate fit between their business strategies and the environment in which they operate since there is no unique or exclusive way of applying the theory (Hallavo, 2015; Kros et al., 2019). This definition shows that contingency theory is situational or depends on the circumstances. This gives CT a reactive character which sometimes can bring some level of complexities when it comes to implementation. This complexity can make it hard for manufacturers to put in place contingency measures and plans. Nevertheless, evidence suggests that contingency theory contributes to improve the firm performance (Dikova et al., 2016; Moore et al. (2018). The theory suggests that in times of complexities as well as high levels of uncertainties, firms must strengthen their internal resources and capabilities through learning, technological innovation and other means that can enable them to improve their performance.

Green supply chain management plays various roles in organisations involved in supply chain activities, which consist of promoting environmental efficiency by reducing the harmful effects of business operations on the environment, fostering the effectiveness of manufacturing activities and that of entire supply chain networks. The scope of GSCM is very broad in its implementation ranging from purchase activities to integration of life-cycle management. It is important to indicate that not all firms view GSCM worth to pursue since it requires substantial amount of resources (financial, technology and human) especially for small businesses. In addition, it is difficult for an organisation to engage in green activities when there is no win-win outcome (financial gain). Furthermore, there are no prescriptive models for measuring GSCM. Different dimensions have been used in literature to measure green practices and to address the concept of GSCM, all of which use different terminologies despite having a common aim which is to minimise and improve environmental performance. The current study measures green practices in terms of green purchasing, eco-design, green manufacturing, green distribution, reverse logistics, legislation and regulation and green training.

3.10 CHAPTER SUMMARY

The present chapter aimed to analyse literature on GSCM, its drivers and challenges, its importance and practices. The chapter discusses three main theories, namely IT, DCT and CT and their implications in guiding the study. It suggests that the discussed theories facilitate better strategical, tactical and operational decisions by leadership to enable organisational performance. The literature shows that the concept of GSCM has been propagating and gaining strategic importance among practitioners as a result of the growing issue of climate change. GSCM demonstrates throughout the present chapter a contribution towards achieving economic, social and environmental performances. For this reason, manufacturing companies need to cement their legitimacy to operate in society by embracing sustainable strategies while pursuing profit maximisation simultaneously.

Moreover, manufacturing companies can build their brand, enhance their reputation and increase their market share through the implementation of green practices. The chapter also suggests that green practices represent a source of technological innovation and development as well as a source of improvement of supply chain networks through integrative, collaborative and cooperative mechanisms. Considering the challenges faced by the manufacturing sector, manufacturing firms must adopt and implement green initiatives to enhance the efficiency, effectiveness and competitiveness of their supply chain networks. This can allow manufacturing firms to match the global trend for cleaner production, cost savings and waste minimisation. The section on research gap analysis proposes a model that incorporates seven GSCMP and assesses their combined impact on SCDC, which in turn leads to higher SCP.

The next chapter discusses SCDC and SCP, as well as the proposed relationships between research constructs.

CHAPTER 4

SUPPLY CHAIN DYNAMIC CAPABILITIES AND SUPPLY CHAIN PERFORMANCE

4.1 INTRODUCTION

This chapter aims to discuss supply chain dynamic capabilities (SCDCs) and supply chain performance (SCP). It further develops an explanatory theoretical framework of green supply chain management practices (GSCMPs) and supply chain dynamic capabilities that translate to higher supply chain performance. The proposed conceptual framework explores the need for manufacturers to create internal and external dynamic competencies through the implementation of green practices to uplift the performance of the supply chain networks (SCNs). In this context, GSCMPs include green purchasing (GP), eco-design (ED), green manufacturing (GM), green distribution (GD), Reverse logistics (RL), legislation and regulations (LR) as well as greeb training (GT). SCP is measured in terms of supply chain agility (SCA), supply chain reliability (SCREL), supply chain responsiveness (SCR), Supply chain costs (SCCs), supply chain quality (SCQ) and supply chain balance (SCB). The chapter starts by discussing SCDC as per Figure 4.1 since GSCMPs are discussed in chapter three, followed by a discussion on SCP. It further presents the conceptual framework that guides the study, formulates hypotheses and ends with the chapter summary.

4.2 SUPPLY CHAIN DYNAMIC CAPABILITIES

In the current study, SCDCs and DCs are used interchangeably by the researcher. The intensification of competitiveness in the business environment has forced firms to fight for their survival by developing business models that enable them to enhance the performance of their SCNs. Performance improvement comes from measures taken by firms to adapt their strategies to the ever-changing market conditions to achieve sustainable development (Alinaghian & Razmdoost, 2017; Inigo & Albareda, 2018). Recent studies suggest that sustainable development in supply chains follows the logical path of materiality and adaptability (Inigo & Albareda, 2018; Chowdhury *et al.*, 2019). This implies that sustainability can be regarded as an adaptative capability, which is translated as DC. DC refers to the ability of a firm to sense, seize new opportunities, and adapt internal competencies to match changes in the SCN as well as in the marketplace (Martin & Bachrach, 2018; Alinaghian *et al.*, 2019). Mousavi *et al*. (2018) and Neise and Diez (2018) also define DC as high-level competencies that allow firms to integrate, develop and reconfigure existing resources (internal and external) to respond to specific market uncertainties.

Moreover, DC describes a process of integrating, building and reconfiguring internal competencies to address changes in the business environment (Teece, 2017). From these three definitions, it is observed that DCs are underpinned by routine activities and skills development, as well as adaptation and innovation within a firm as a result of market developments. This view is also echoed by Mousavi *et al.* (2018) who stress that DCs represent an accumulation of experiences and routine activities through which firms achieve new configurations and competencies. From this perspective, the current study defines DCs as the ability of a firm to utilise its existing competencies effectively and efficiently, explore other relevant competencies, tackle inefficiencies in supply chains, adjust business models and foster technological innovation.

It is suggested that DCs derive from the uniqueness of the firms' assets, experiences accumulated over many years in their field of expertise as well as the acquisition of new competencies through learning mechanisms (Li *et al.*, 2018). This argument is consistent with Giniuniene and Jurksiene (2015) as well as the view of Teece (2017), who argue that DCs represent strategic competencies which encompass two hierarchical levels, allowing firms to respond to market uncertainties. Accordingly, the lower level consists of routine activities, ordinary capabilities and administrative functions to pursue a given production programme and the upper-level capabilities, which include two sub-levels of capabilities, namely the micro-foundations and high-order level. The micro-foundations provide means by which firms adjust and reconfigure existing ordinary capabilities and develop new ones. They also represent the segment that drives innovation, market expansion and foster synergetic relationship across business divisions. The high-order level represents the most relevant component that provides visionary perspectives to micro-foundations, develops business models that reflect the market changes, senses and seizes new opportunities, determines the best configurations to meet long-term objectives (Teece, 2017). It is important to emphasise that the upper-level capabilities are concerned with product development and market expansion through sensing, seizing and transforming the capabilities to enable sustainable development. All these hierarchical levels are essential ingredients to generate and diffuse new technology as well as capture value into the SCNs (Gölgeci *et al.*, 2019).

The concept of DC has emerged to a point to spread its influence across the firm boundaries. Alinaghian and Razmdoost (2017) stress that cooperation, collaboration and knowledge sharing benefit all members of the SCN and strengthen the capacity to respond to challenges adequately. It is further suggested that DCs play a vital role in the SCNs as they foster and promote investments in technologies that advance a common interest, help develop effective marketing capabilities among partners, of which lead and contribute to an increase in market share (*Ibid*). Frasquet *et al.* (2018) also point out that DCs foster network embeddedness, which is related to supply chain issues such as connectivity, heterogeneity and change. It is further argued that learning and networking capabilities are essential for rapid penetrations into international markets because they encourage knowledge acquisition and learning (Frasquet *et al.*, 2018).

Incorporating DCs into the SCN supports the implementation of supply chain-related strategies such as lean, GSCM and agility strategies and further contributes towards achieving a supply chain competitive advantage (Liu *et al.*, 2017). Similarly, Liu *et al.* (2017) suggest that integrating GSCM into the supply chain requires DCs since firms may need to redeploy their resources, skills and knowledge to adapt to challenges inherent in selecting adequate suppliers and partners. For instance, the multinational company Unilever collaborates with its partners to leverage expertise and capabilities across its SCNs that lack competencies to achieve superior performance (Liu *et al.*, 2017). This view is also echoed by Liao *et al.* (2017), who point out that collaboration minimises uncertainties and enhances the efficiency of the supply chain, which in turn can result in increased competitiveness.

Dynamic capability is characterised by its ability to address the rigidity of routine activities, sense and seize business opportunities, innovate and adapt to market conditions (Li *et al.*, 2018). The strength of DC of any given firm is associated with its level of readiness and preparedness, its resources and its capacity to absorb rapid changes in market conditions (Teece, 2017; Gölgeci *et al.* 2019). This implies that strong and reliable DCs are those that are able, in times of high level of competitiveness and sophistication of consumer needs, to respond rapidly and adequately to these changes through innovative initiatives and adjusted business models. Gölgeci *et al*. (2019) also argue that in international markets, for example, firms with strong DCs are those that can respond timeously and demonstrate effective coordination and efficient redeployment of internal and external resources. Mousavi *et al.* (2018) suggest that adopting new configurations is indicative of the relationship that exists between DCs and the firm's ability to embrace innovative activities through technological development.

A study by Lin *et al.* (2015), aimed at measuring the influence of four dynamic capabilities (sensing, absorptive, relational and integrative capabilities) on four stages of the innovation process (initiation, outside search, proposal establishment and implementation), based on a survey of 264 Chinese firms using the Partial Least Squares Structural Equation Modelling (PLS-SEM) approach, indicates that relational capability facilitates sensing capability, absorptive capacity and integrative capability. Furthermore, all these capabilities affect the stages of the adoptive management innovation process, from initiation through to implementation. Similarly, Mousavi *et al.* (2018) investigated how DCs affect innovation capability for sustainable development, using cross-sectional data from the Community Innovation Survey of German companies to test hypotheses. The results from PLS-SEM analysis show that sensing, seizing and reconfiguring capabilities all have a significant direct effect on innovation towards sustainability, with sensing activities playing the most prominent role. It also found that reconfiguring capabilities positively influence sensing as well as seizing capabilities and that they partially mediate the relationship between reconfiguring capabilities and companies' sustainable innovation.

Conversely, there have been debates concerning the nature and concept of DCs as well as their origin, effects and consequences on performance (Andreeva & Ritala, 2016; Rodrigo-Alarcon *et al.*, 2017). It is argued that DCs are built on two main contexts: the first is considered to represent the industry best practices, which bears some levels of similarities among members of the same industry. The second context is concerned with the firm-specific resolve which entails that, resources and competency are unique to a firm and are the source of a sustainable competitive advantage (Andreeva & Ritala, 2016; Rodrigo-Alarcon *et al.*, 2017; Liu *et al.*, 2018; Gruchmann *et al.,* 2019). For instance, a study by Frasquet *et al.* (2018) in the retail fashion industry aimed to understand how and which DCs of a retailer aid its embeddedness in an international market, differentiates DCs into firm-specific capabilities and generic capabilities and the findings show that generic DCs which are common among firms play a positive role in enhancing firm-specific capabilities.

Moreover, Martin and Bachrach (2018) argue that DC attributes may vary depending on the context dynamism. The authors argue that in a moderate and stable business environment where competitors and consumers are well known, DCs tend to be effective and efficient, whereas in a highly turbulent market where competition is intensive, boundaries become blurred and customer needs shifting when DCs are more emergent, iterative and rely more on new knowledge acquisition for a specific situation. Despite the contradiction in DC approach, the current study adopts its own definition developed and based on the synthesis of definitions from Teece (2017), Martin and Bachrach (2018), Mousavi *et al.* (2018), Neise and Diez (2018) and Alinaghian *et al*. (2019) spelled out at the beginning of this chapter. DC is defined as the ability of a firm to utilise its existing competencies effectively and efficiently, explore other relevant skills, exploit inefficiencies into the supply chain, adjust business models and foster technological innovation.

Moreover, DC is diverse in its concept and measures, which makes it challenging to establish and adopt a common conceptual framework (Liu *et al.*, 2018; Gruchmann *et al.*, 2019). For instance, a study by Gölgeci *et al.* (2019), based on 254 Turkish international firms conceptualised DCs as innovativeness, supply chain agility and adaptability. Garmann-Johnsen and Eikebrokk (2017) used DCs as process-oriented and alliance oriented. Furthermore, network-oriented activities are considered as DCs in a study by Alinaghian and Razmdoost (2017). As a result of these broad views, the current research adopts the classification by Rodrigo-Alarcon *et al*. (2017) which identifies DCs in three dimensions: adaptative capability, which entails taking advantage of opportunities that arise in the supply chains; absorptive capacity, which represents the ability of a firm to collaborate, integrate, coordinate and exploit information from business intelligence for commercial purposes; and innovative capability, which refers to the ability to generate new competencies resulting in product development and processes (i.e. green production). The current study groups all those three dimensions into single research construct configured as SCDC, suitable to compete and achieve sustainable competitive advantage in a dynamic environment.

4.3 SUPPLY CHAIN PERFORMANCE

Supply chain management is concerned with the management of supply chain activities from procurement of raw materials to the end-users (Jagan *et al.*, 2019). SCM connects all stakeholders of the SCN and facilitates the exchange of products and services, money and information (Love *et al.*, 2019). Managing supply chain activities aims at improving the effectiveness and the efficiency of the supply chains, adding value and setting standards (Lima-Junior & Carpinetti, 2017; Love *et al.*, 2019). An effective SCM requires that the network performance indicators be assessed to determine the level of performance since financial and competitive implications are involved (Katiyar *et al.*, 2017). Thus, it is vital to measure the performance of the supply chain as it allows managers to make informed and better strategic decisions regarding the well-being of supply chain processes and operations (Sangari *et al.*, 2015; Abdallah *et al.*, 2017).

Supply chain performance describes a systematic process of assessing supply chain activities to determine the effectiveness and efficiency of the SCN (Sundram *et al.*, 2016). SCP can also be defined as operational activities designed to improve the performance of the SCNs as well as that of supply chain members (Odongo *et al*., 2017; Lima-Junior & Carpinetti, 2019). Moreover, SCP represents the management of supply chain activities in terms of logistics and cross-functional interactions to determine the level of performance (Lima-Junior & Carpinetti, 2019). Based on definitions from Odongo *et al.* (2017) and Lima-Junior and Carpinetti (2019), the present study defines SCP as the outcomes of supply chain activities, which include agility, reliability, costs, responsiveness, quality and balance. From the above definitions, it can be observed that SCP involves a holistic assessment of intra- and inter-organisational activities. These activities are managed and coordinated in a way that provides effectiveness and efficiency to the SCN and offers better benefits for supply chain members.

Many firms still pursue the traditional concept of SCP, which focussed mainly on financial gains of the supply chains as well as the timely delivery of products and services (Ramezankhani *et al.*, 2018). Recent research has focussed on designing inclusive systems that cater for financial and non-financial gains of the SCNs through strategic, tactical and operational decisions (Elgazzar et al., Tipi & Jones, 2019; Lima-

Junior & Carpinetti, 2019). Hemalatha *et al.*, (2017) suggest that it is necessary to identify adequate evaluation tools as they can allow firms to set strategic objectives, appraise SCP and effectively manage future perspectives. Similarly, Lima-Junior and Carpinetti (2019) stress that measuring the performance of the SCN is driven by factors which include:

- Success identification – firms are able, in this case to track and measure areas of progress.
- Customer satisfaction – products and services meet customer requirements.
- Know-how assessment – firms can clearly analyse the outcome of their operations.
- Informed decision-making – managers can make appropriate decisions based on facts to enhance SCP.
- Evaluation against specifications or standards – firms are able to compare the outcome of their supply chain operations with the relevant specifications and industry guidelines.

Performance indicators in supply chains can help set evaluation criteria. They can be qualitative and/or quantitative and provide managers with valuable information to determine which characteristics of the supply chain processes and operations need improvement (Lima-Junior & Carpinetti, 2017; Sufiyan *et al.*, 2019). Evaluating the SCN requires that firms use metric systems connected to specific performance targets such as cost, agility, responsiveness and flexibility, among others (Lima-Junior & Carpinetti, 2017). Lima-Junior and Carpinetti (2019) further report that the choice of appropriate key performance indicators (KPIs) requires adopting leading metrics which focus on the drivers of performance (i.e. product quality, constructs of operational performance, among others) and lagging metrics, which measures operational outcomes (i.e. customer satisfaction). This exercise can allow supply chain members to have a solid understanding of various KPI types for a successful SCN.

A suitable assessment of supply chain processes and operations can ensure the proper allocation of resources as well as adequate settings for long-term objectives (Elgazzar et al*.,* 2019). SCP promotes collaboration between members of the supply chain, ensures continuous improvements and indicates whether firms are on the path of financial stability and operational excellence (Sundram et al*.* 2016). Similarly, Odongo *et al.* (2017) establish that collaboration in the supply chains helps reduce costs, minimise in-stock inventories and improve quality. For example, a study by Seiler *et al.* (2020) aimed at evaluating the effect of linkage between organisations in the SCNs and performance that target SMEs in a German automotive plastics processing industry, suggests that network connectedness improves SCP through technical efficiency as well as profitability and market share.

Moreover, Ojha *et al.* (2019) postulate that coordination practices in the SCN contribute towards enhancing the effectiveness and efficiency of the supply chain through reduced inventory costs, logistics and distribution costs. For example, Dell integrated supplier-logistics information systems and Cisco's Virtual Manufacturing Model and both entities share information with channel members to enable reduced system-wide inventory costs through better coordination while also simultaneously improving both order fulfilment and delivery performance (Ojha *et al*., 2019). Peng *et al.* (2020) further argue that strong coupling between supply chain members enhances trust, reduces communication costs, facilitates technology transfer and augments the amount of useful knowledge for competitive advantage. The study designs evaluation criteria that are presented in Table 4.1 and will help determine the level of effectiveness and efficiency of supply chains in the South African manufacturing sector.

Literature suggests that there is no single way to measure SCP. Numbers of authors have used various constructs to evaluate the performance of supply chains (Katiyar *et al.*, 2017; Sufiyan *et al.*, 2019). For instance, a study by Sangari *et al.* (2015) evaluated the performance of supply chain in terms of four Supply Chain Operations Reference (SCOR) process elements: Plan, Source, Make and Delivery using Structural equation modelling from a sample of 78 Iranian manufacturers in the mechanical and engineering industry. Hemalatha *et al.* (2017) used a hybrid methodology of Attribute Hierarchy Model (AHM) and Membership Degree Transformation- M (1, 2, 3) to evaluate the SCP of petroleum products. Abdallah et al. (2017) used financial and non-financial dimensions to measure the performance of the supply chain. Hallavo (2015) measured SCP in terms of operational (lead-time, on-time deliveries, work-in-process inventories, finished-goods inventories, in-stock rates) and organisational performance (profits, revenues, market share and growth) perceptions of power and its effect on SCP. Odongo *et al.* (2017) measured SCP in terms of efficiency, responsiveness, quality and chain balance. In contrast, Lima-Junior and Carpinetti (2019) proposed a combination of SCOR metrics and adaptive network-based fuzzy inference systems (ANFIS) to evaluate the SCP. Similarly, Kamble *et al.* (2019) used Data Analytic Capability (DAC) and SCOR frameworks to assess the supply chain visibility in the Agri-food supply chain. Finally, Sufiyan *et al.* (2019) employed the approach of fuzzy Decision-Making Trial and Evaluation Laboratory (DEMATEL) and DANP (DEMATEL based Analytic Network Process) methods to evaluate the SCP of the food supply chain.

The above studies provide guidance for the current research and as a result, the study adopts the performance dimensions, which include agility, reliability, costs, responsiveness, quality and balance from authors listed in Table 4.1.

Table 4.1: Performance Attributes Suggested for the current Study.

Attributes/constructs	Descriptions	Sources
Agility	refers to the ability to adjust and adapt strategies and competencies timeously to respond to changes in the supply chain.	Gölgeci *et al*. (2019)
Reliability	represents the ability to perform task as expected.	Lima-Junior & Carpinetti (2019)
Costs	represent expenses incurred in operating supply chain processes and include, labour costs, material costs, management and transportation costs.	Lima-Junior & Carpinetti (2019)
Responsiveness	refers to the speed in which product requests are resolved resulting in satisfaction.	Odongo *et al.* (2017)
Quality	refers to the ability to deliver on quality requirements which include safety, product quality.	Geyi *et al.* (2019)
Balance	refers to the distribution of risks and benefits throughout the SCN.	Odongo *et al*. (2017)

Source: Author's own compilation.

Table 4.1 portrays a set of six attributes/constructs that can be used to measure the performance of supply chains in the South African manufacturing sector. As far as Table 4.1 is concerned, agility, reliability, responsiveness and quality constructs are customer-focussed and deal with the level of effectiveness of supply chain processes, whereas costs and balance constructs are internally focussed and translate organisational efficiency. The study proposes that these attributes can all contribute towards helping South African manufacturers deliver products and services that fulfil customer requirements, resulting in sustainable competitive advantage.

The diversity in evaluating the SCP has been a source of debates in the literature to find a suitable way of assessing performance (Sufiyan *et al.*, 2019). This diversity demonstrates a lack of integrated performance evaluation systems. It also implies a lack of consistency in providing a common outcome since a variety of constructs has been used to evaluate the SCP. Some studies have combined different methods of evaluation to assess the performance of the supply chains (Kamble *et al*., 2019; Lima-Junior & Carpinetti, 2019; Sufiyan *et al.*, 2019). This strategy may have been adopted to complement the weaknesses of each individual method with the aim of providing reliable outcomes for accurate decision-making processes. The combination of methods may also indicate that scholars and practitioners may have tried to find essential performance criteria and KPIs that provide better performance measurements. Consequently, Hallavo (2015) argues that in a context of low uncertainties in the business environment, firms must mostly focus on efficiency and lean strategies in their supply chains. In contrast, in a highly turbulent and dynamic context, they must instead focus on dimensions of the SCP that include responsiveness, agility and flexibility. Therefore, the study uses six concepts to demonstrate the performance of the supply chain in the South African manufacturing sector. The study measures the SCP in terms of SCA, SCREL, SCR, SCC, SCQ and SCB. These dimensions of the supply chain are discussed in Section 4.6.

Despite efforts made to propose various ways of measuring SCP, awareness needs to be enforced to create balanced supply chains that preserve the interests of all supply chain members and those of consumers (Elgazzar et al., 2019). An effective evaluation of the supply chain can add value to supply chains and help achieve organisational objectives by monitoring the effective deployment of resources across the SCN to raise profitability.

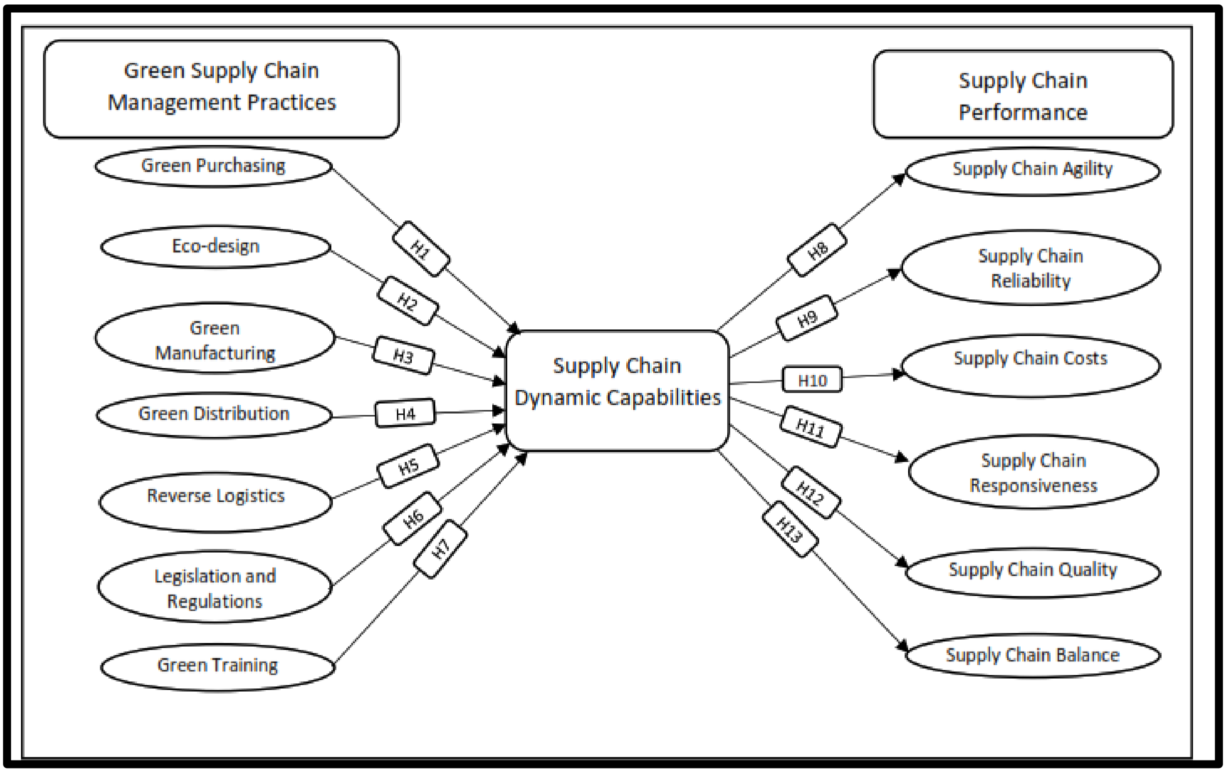
4.4 CONCEPTUAL FRAMEWORK AND DEVELOPMENT OF HYPOTHESES

Institutional, dynamic capability and contingency theories discussed in Chapter 3 have been identified as suitable theoretical frameworks to underpin the current study. IT helps understand the role of legislation and regulations in shaping the implementation of GSCM, DCT helps explore new opportunities, exploit inefficiencies within the SCNs and adapt business models for a better SCP, while CT contributes towards the understanding of how internal competencies are deployed to provide strategic and situational responses to complexities and market uncertainties for enhanced performance. Consequently, the current study proposes the conceptual framework in Figure 4.1 that posits a relationship between GSCMPs, SCDC and SCP. Moreover, Figure 4.1 illustrates the theoretical model that guides the current study and offers some insights into enablers and mediators of GSCMPs and the resultants of SCP. The following section presents the conceptual framework, discusses and develops hypotheses.

4.4.1 Conceptual framework

Figure 4.1 portrays the conceptual model that summarises the interrelationships between GSCMPs in the South African manufacturing sector and SCDCs, which in turn lead to higher SCP. In Figure 4.1, independent variables include GP, ED, GM, GD, RL, LR and GT. These independent variables have been discussed in the preceding chapter, but their relationships with the mediation variable are discussed in the current study. SCDCs represents a mediating variable that may affect the implementation of GSCMPs, whereas dependent/outcome variables include SCA, SCREL, SCC, SCR, SCQ and SCB. These outcome variables and their relationships with SCDCs are discussed in the following sections.

Figure 4.1: Theoretical conception framework



Source: The author's own compilation.

The hypotheses developed from Figure 4.1 are intensively discussed in sections 4.5 and 4.6 of the current chapter.

4.5 PROPOSED RELATIONSHIP BETWEEN GREEN SUPPLY CHAIN MANAGEMENT PRACTICES AND DYNAMIC CAPABILITIES

Green supply chain management practices represent those initiatives taken by firms to reduce the adverse effects of their operations on the environment while improving the sustainability of their SCNs. The current study focusses on green practices that have been intensively used and discussed in the literature and include, green purchasing, eco-design, green manufacturing, green distribution, reverse logistics, legislation and regulations and green training. Although research studies combining GSCMPs and SCDCs are rare, few studies have established the relationships between green practices and firms' ability to innovate for a sustainable advantage (Essid & Berland, 2018; Gruchmann & Seuring, 2018; Mahmud *et al.*, 2020). GSCMPs are an integral part of SCDC since its attributes possess a potential to shape the management of a supply chain and enable the development of practices needed to achieve the required level of performance (Kähkönen *et al.*, 2018). Moreover, Kähkönen *et al.* (2018) argue that proactive environmental strategies, such as GSCM, foster the development of unique organisational capabilities for a continuous supply chain improvement. Similarly, Mahmud *et al.* (2020) stress that sustainable practices force firms to explore new areas of research and technology, resulting in products that incorporate green features. AlNuaimi and Khan (2019) argue that when a given firm focusses on sustainability, it is highly likely to ensure its ability to innovate in green areas such as green practices under consideration in the current study.

4.5.1 Green purchasing and supply chain dynamic capabilities

The first hypothesis in Figure 4.1 (H1) illustrates the positive influence GP may have on SCDC. GP has been discussed in SCM studies that are linked to organisational capabilities as its functions have the ability to strategically contribute to improve competencies and promote the success of supply chains (Yook *et al.*, 2017; AlNuaimi & Khan, 2019). GP is also recognised by its traditional criteria of assessing suppliers based on costs, products quality, lead time and environmental performance (Ji *et al.*, 2015; Mohammed, 2020). Firms need specific capabilities in order to successfully manage the implementation of GP activities, which include selection, development, collaboration and evaluation of suppliers (Foo *et al.*, 2019; Picaud-Bello *et al.*, 2019). Furthermore, when a firm has reached GP maturity, it can develop capabilities for efficient purchasing activities as well as for supplier relationship management (Kähkönen *et al.*, 2018).

Large manufacturers across the world consider GP strategy as a key component to enhance supply chain sustainability and use it as a tool to select, evaluate and integrate suppliers (Choi *et al.*, 2018). For example, VW has designed purchasing programmes that allow the firm to carefully evaluate and select its suppliers (Liu *et al.*, 2019). Murfield and Tate (2017) posit that buyer-supplier purchasing relationship contributes towards designing environmentally friendly products and processes, operations and proper resource allocation. It is suggested that GP strategy is linked to organisational capability (operations) since it plays a supporting role in supply chains in ensuring higher performance (Yook *et al.*, 2017).

A number of scholars investigated the relationship between GP and SCDC (AlNuaimi & Khan, 2019; Liu *et al.*, 2019). For example, in a study by Ji *et al.* (2015), GP practices stimulate the development of evaluation capabilities through cooperation and collaboration with suppliers to improve the performance of the supply chain. Similarly, Picaud-Bello *et al*. (2019) posit that GP strategy facilitates cooperation and coordination between new product development of focal firms and supplier resources. Moreover, through the lens of DCT and in the context of digital technology, Bag *et al.*, (2019) found that digital procurement/purchasing under circular economy helps reinforce skills development through continuous education and training, promote the buyer-supplier relationship and enable technologies that can be useful to feed timely information and optimise procurement process. Based on these arguments, the study hypothesises that:

H_1: Green purchasing (GP) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.5.2 Eco-design and supply chain dynamic capabilities

The second hypothesis in Figure 4.1 (H2) explicitly states the positive influence ED may have on SCDC. The rising issue of environmental pollution puts enormous pressures on all stakeholders of the SCN to work in concert to improve the effectiveness and efficiency of their supply chains. Choudhary and Sangwan (2019) report that 80 per cent of products aimed at improving environmental performance is done at the design stage and require intra- and inter-organisational collaboration. Collaboration and cooperation with suppliers, consumers, business partners, among others foster technological innovation, which is beneficial for firms in designing products and manufacturing processes (Seman *et al.*, 2019). For instance, Ford has spent considerable efforts and money to develop strong relationships with its suppliers to encourage shared commitment as well as supply chain capabilities (Liu *et al.*, 2018). Firms generally aim to develop their suppliers through decent communication and collaboration, knowledge sharing, training and monitoring (Bag *et al.*, 2018). This development of skills and knowledge of suppliers is in line with the principles of SCDCs and drives the performance of the supply chain.

Effective ED strategy represents a first step towards improving internal coordination between functions and creating synergies with dedicated resources, efficient information management and training management (Liu *et al.*, 2018). This view follows the rationale of SCDC, which requires firms to adopt strategies that match their resources and capabilities. For example, the active involvement of logistics/SCM departments in the ED process may help automakers to select qualified suppliers in new product development (Liu *et al.*, 2015). Moreover, manufacturers such as Panasonic, Mazda and Nissan used ED as a value-creating strategy through which they provide their know-how and expertise to the benefit of SCNs and to improve organisational performance (Liu *et al.*, 2018). The integration of suppliers into the focal firm network promotes cooperative activities and knowledge sharing, especially where suppliers' innovative technology can be brought into ED process to enhance its performance (Liu *et al.,* 2015).

Several studies have provided empirical evidence of the relationship between ED and SCDC. For example, a survey-based approach study, from 216 automakers across the globe by Liu *et al.* (2018) used ED to examine how it informs SCDC. Aguiar, Gonçalves, Gonçalves and Bottinger (2019) used ED to develop a service-based integrated prototype framework for reusable modular assembly systems. Through a case study, Scur *et al.* (2019) investigated how leading companies in Brazil's heavyweight vehicles manufacturing industry introduced ED strategy into the engine development process. The study found that ED strategy fosters process and product innovations, which is an essential ingredient for green strategies. Moreover, ED strategy requires the redeployment of resources (internal and external) to attain ecological efficiency and meet customer requirements (Abdallah & Al-Ghwayeen, 2019). Based on these views, the current study argues that ED is enabled by a strong integration of resources and capabilities. Thus, the study hypothesises:

H_2: Eco-design (ED) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.5.3 Green manufacturing and supply chain dynamic capabilities

The third hypothesis in Figure 4.1 (H3) relates to the positive influence GM may have on SCDC. GM strategy is mainly supported by technological innovation and organisational capabilities to drive sustainable development (Seth *et al.*, 2018; Zhang *et al.*, 2019). Zhang *et al.* (2019) stress that implementing GM requires a sound organisational structure which must include, method and technology, platform and operations, application and verification, assessment and demonstration. Additionally, GM represents a core function of green strategies as it incorporates product design, green technology and production and its practices are implemented throughout the products' life cycle (Belhadi *et al.*, 2019). GM strategy and technological innovation go hand in hand as their combined characteristics contribute towards enhancing sustainable capabilities which are required to improve the performance of the supply chain through low cost, large volumes and high-quality products (Bai & Sarkis, 2017; Belhadi *et al.*, 2019).

Several research studies discussed the interlink that exists between GM and SCDC. They include Singh *et al.* (2019), who ascertain that GM strategy represents a catalyst that drives innovative development through the production of clean production. Zhang *et al.* (2019) used GM to develop a general reference model and customised frameworks of green technology for industrial companies. The study suggests that these model and frameworks can help improve the implementation of GM technologies, GM processes, reduce the environmental impact of resources and ultimately enhance the comprehensive green rate of enterprises. In addition, viewed from the DCT perspective, Ghobakhloo *et al.* (2017) revealed that GM and information technology (IT) are complementary and inter-dependent. In this sense, the authors argue that IT capability serves as a lower-order capability that can be leveraged to develop the higher-order capability of GM effectiveness. Furthermore, Ghobakhloo *et al.* (2017) ascertain that GM promotes the development of environmental capabilities resulting in superior performance.

It is important to note that GM practices involve the manipulation of complex systems that may require firms to develop new competencies, redeploy resources and capabilities adequately for a sustainable competitive advantage (Liu *et al.,* 2015; Belhadi *et al.*, 2019). In line with this assertion, Liu *et al*. (2015) stress that GM strategy plays a crucial role in developing and improving (internal and external) competencies. Thus, the study posits the adoption and implementation of GM may facilitate reconfiguration of internal and external competencies to achieve superior SCP. The study hypothesises:

H_3: Green manufacturing (GM) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.5.4 Green distribution and supply chain dynamic capabilities

The fourth hypothesis in Figure 4.1 (H4) involves the positive influence that GD may have on SCDC. A distribution channel represents a vertical market network, where a focal firm, mostly manufacturers, is at the centre of the network. The role of the focal firm is to organise and coordinate relationships with upstream suppliers and downstream distributors as well as the flow of information (Kirono *et al.*, 2019; Qian *et al.*, 2019). GD strategy is incorporated in the distribution channels and covers a range of supply chain activities that include a selection of the best transportation means, load carriers and transportation routes, among others, to quickly respond to market demands and reduce the effect of business operations on the environment (Petljak *et al.*, 2018). As a result, firms are required to develop competencies and capabilities to help supply chain members improve their efficiency and effectiveness. For example, firms can develop computation intelligence capabilities to allow them to determine optimum distances and choose suitable distribution centres for improved SCP (Petljak *et al*., 2018).

Since business environments become more and more dynamic as a result of the ever-changing nature of environmental regulations, customer needs and their geographical locations, it becomes paramount for manufacturers to build strategic relationships with suppliers to better manage the entire supply chain and achieve organisational objectives (Murfield & Tate, 2017). For example, Zara, an international fashion company, was able to quickly react to rapidly changing consumer demands in the 1990s by operating a fast-response distribution network due to information sharing and inter-organisational trust (Qian *et al.*, 2019). Moreover, to cope with these drastic changes in the field of GD, DC is the promising lens for sustainable development due to its ability to adapt to the business environment by developing appropriate business strategies that include forming new business partnerships or developing new strategic alliances with suppliers for enhanced performance (Ghadge *et al.*, 2017; Gruchmann *et al.*, 2019). GD strategy requires firms to innovate and undertake the path towards a technological transformation (Calderon *et al.*, 2019). This transformation also requires investing in building resources (human and capital), which may vary from one company to another.

Green distribution requires manufacturing firms to build strategic relationships with business partners and suppliers through which knowledge is shared to facilitate the improvement of supply chain capabilities (Calderon *et al.*, 2019). To effectively manage distribution structures, SSCM/GSCM can be considered as a routine activity that forms part of DCs in the supply chain which is used to enhance the overall performance (Gruchmann *et al.*, 2019). GD also facilitates collaboration and cooperation with suppliers in matters of sustainability and requires firms to build and develop competencies and capabilities for a successful SCN (Petljak *et al.,* 2018). Through collaborations, firms are engaging in inter-firm networks that give them access to useful information, allow them to benefit from resource flows, develop network capabilities and refine their skills (Qian *et al.*, 2019).

Relying on a theoretical framework of the resource-based view that complemented DC perspectives, Carbone *et al.* (2019) showed that companies could sustain positive and superior social performance in their supply chains by leveraging DCs developed in the environmental field, which is GD in this case. In addition, their study revealed that SSCM practices, which include GD enhance relational capabilities and which in turn lead to superior performance. As part of their research findings, using a resource-based perspective, Çankaya and Sezen (2019) found a positive relationship between GSCMPs, which include GD and organisational performance through strategic resources and capabilities. Gruchmann et al*.* (2019) argue that the relations between SSCM/GSCM practices which includes GD and DC are bidirectional in the sense that they mutually interact. Consequently, there are causal relationships that exist in which green practices enforce DCs and where DCs influence the implementation of green practices. For the sake of the present study, it is suggested that GD enforces DCs. As a result, it is crucial to investigate the influence GD practices may have on SCDC to encourage their implementation. Based on this observation, the study hypothesises:

H_4: Green distribution (GD) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.5.5 Reverse logistics and supply chain dynamic capabilities

The fifth hypothesis in Figure 4.1 (H5) deals with the positive influence RL may have on SCDC. RL strategy represents a process of retrieving used/damaged products from consumers to their point of origin for remanufacturing and/or friendly disposal (Hsu *et al.*, 2015; Jaaron & Backhouse, 2016). RL is designed to offer not only to supply chain, but also environmental sustainability benefits through returns to resell, refurbish, recondition, remanufacture, or recycle products to minimise environmental pollution (Jaaron & Backhouse, 2016; Morgan *et al.*, 2017; Mahadevan, 2018). RL process adds value to products, fosters customer satisfaction and loyalty through dedicated resources meant at enhancing the SCP (Hsu *et al.*, 2015; Pal, 2016; Mahadevan, 2018). It is estimated that product returns cost US firms approximately $100 billion each year, representing around 3.8 per cent contraction in profitability (Morgan *et al.*, 2016). In the UK also, it is reported that product returns cost firms around six billion British pounds every year (Jaaron & Backhouse, 2016). Thus, it is important to develop RL competencies to transform return cost centre into a profit maximisation centre. For example, firms such as Xerox, Canon, Estée Lauder, Caterpillar and Nike have successfully managed to create and redeploy their resources and capabilities to improve RL competencies for better organisational performances (Morgan *et al.*, 2016).

A company's prospect and growth are the result of internal competency development rather than a result of market conditions (Morgan *et al.*, 2016). Morgan *et al.* (2016) further stress that competencies arise from the reconfiguration and redeployment of existing resources, which result in improved performance. SCDCs contribute towards achieving RL performance through the development of innovative competencies and capabilities. The reconversion of skills allows firms to manage product returns more effectively and efficiently for the benefit of SCNs (Mahindroo *et al.*, 2016; Pal, 2016). Morgan *et al.* (2017) suggest that deploying resources allows firms to set up organisational structures that support RL strategy for a sustainable supply chain development.

Using a survey questionnaire from 267 supply chain professionals, Morgan *et al.* (2016) analysed the influence of DC, which includes collaboration and information technology (IT) on RL and found a positive moderating influence of IT competencies on RL strategy. Similarly, Mahindroo *et al.* (2016) analysed the impact of a conceptualised IS framework on achieving RL strategic outcomes under the individual moderating influence of resource commitment (RC) and IT capability. The study revealed that resource commitments improve RL performance. Similarly, Morgan *et al.* (2017) showed that resource commitments might be used to develop a sustainable RL capability. As part of his research findings, Mahadevan (2018) argues that integrating tools, systems and techniques with RL processes through collaborative frameworks will increase the performance and productivity of RL operations. De Paula *et al.* (2018) stress that RL practices promote resource sharing and technological development for a superior supply chain performance. Although RL practices may vary across industrial sectors, it becomes logical and vital to analyse the strategic relationship that exists between RL and SCDC. Therefore, the study suggests that RL may allow manufacturers to develop systems and technologies that improve the efficiency of the SCN. Based on these observations, the study hypothesises:

H_5: Reverse logistics (RL) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.5.6 Legislation and regulations and supply chain dynamic capabilities

The sixth hypothesis in Figure 4.1 (H6) relates to the positive influence LR may have on SCDC. It is often suggested that new knowledge is a product of a combination of different capabilities, which result in the reconfiguration of existing knowledge to yield new and improved knowledge and skills. This combination of knowledge in this context represents a system capability which refers to the degree to which regulations and guidelines foster the enhancement of competencies (Sheng, 2017). Moreover, the interaction between lawmakers and professionals provides firms with the ability to reconfigure their resources into a value-creating mechanism for better performance (Martin & Bachrach, 2018). Similarly, Seman *et al*. (2019) stress that the interaction between stakeholders of the SCN creates a conducive environment for innovations to comply with LRs. For example, industrial norms and standards can help improve knowledge and competencies.

A number of studies have explored the relationship that may exist between LR practices and SCDC. For instance, Hidalgo-Peñate *et al.* (2019) argued that LR practices, when studied under the context of DCT, may exert an influence on SCDC as per hypothesis 6 on Figure 4.1. Garmann-Johnsen and Eikebrokk (2017) examined the effect of caregiver shortage, collaborative networks in Norwegian municipalities using DCT as a general theoretical lens and a process orientation framework for operationalisation. The authors used a cross-sectional interview to validate the existence of alliance orientation (AO) and process orientation (PO) as well as their relationship. The study revealed that AO and PO are driven by government policies and contribute towards fostering the development of innovative capabilities as well as the adoption of long-term business models.

Furthermore, Huang *et al.* (2019) used an integrative approach to investigate the effect of government policies and regulations on green technology. The study revealed that LR practices influence the adoption and implementation of technology that minimises the effects of business operations on the environment. It is important to stress that green technology requires the adjustment of competencies and change of processes as well as changes in organisational culture. Scur *et al.* (2019) investigated how technology-forcing regulations affect the product development process in the supply chain of heavyweight vehicles, using a case study with a quantitative approach. The study revealed that technology-forcing regulations play an essential role in enhancing the adoption of eco-design technology, but the market and competitive conditions also play a meaningful role. Based on these studies, the current study then formulates that:

H_6: Legislation and regulations (LR) exert a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.5.7 Green training and supply chain dynamic capabilities

The seventh hypothesis in Figure 4.1 (H7) involves the positive influence GT may have on SCDC. GT refers to a process of upskilling personnel's ability to perform green tasks, promote green creativity and innovate for a sustainable competitive advantage (Pratono *et al.*, 2018; Ogbeibu *et al.*, 2019). GT practices foster awareness on ecological issues, promote personnel involvement in green initiatives and green creativity and serve as a motivator to advance green product development and innovative capabilities (Ogbeibu *et al.*, 2019). As stressed by Leal-Millán *et al.* (2015) and Albort-Morant *et al.* (2017), innovation can be considered as a technological knowledge that derives from a combination of knowledge and abilities from which capabilities are created, that makes it possible to generate new products and services. GT strategy can help personnel to cultivate and build green culture, which is a key capability designed to help gather, organise and use resources to develop sustainable practices (Albort-Morant *et al.*, 2017; Minbashrazgah & Shabani, 2018). Similarly, Tallott and Hilliard (2016) stress that learning through GT facilitates the development of DCs by improving the firm abilities to adapt to changes.

Learning through GT generates knowledge, which fosters absorptive capability enhancement, which in turn leads to improved innovation capabilities for a sustainable competitive advantage (Leal-Millán *et al*., 2015; Minbashrazgah & Shabani, 2018; Muraliraj *et al.*, 2018). Creativity can be encouraged, developed and improved by providing employees with adequate training programmes that allow them to perform their duties with confidence and reliability. Moreover, GT can expand personnel skills, know-how and create an innovative atmosphere within a firm to support creativity and new product development (Leal-Millán *et al.*, 2015). Learning through experiences facilitates the accumulation of knowledge which in turn stimulates the ability to resolve challenges faced with ease and dedication (Tallott & Hilliard, 2016; Scholten *et al.*, 2018). Minbashrazgah and Shabani (2018) posit that GT fosters the adoption and implementation of green technologies for superior ecological performance as well as better efficient SCNs.

Some firms across the world differentiate themselves from others by developing organisation-oriented training programmes based on internal capabilities and business intelligence reports (Yang *et al.*, 2018). For example, Toyota is widely recognised for its leadership in enforcing organisational learning and continuous improvement. The company relies on three principal processes, which include supplier associations, consulting groups and learning teams to form a high performing knowledge-sharing network (Yang *et al.*, 2018). This assertion is in line with the concept of DC, which provides personnel with the ability to scan and sense environmentally related issues, tackle challenges with confidence and propose appropriate solutions (Minbashrazgah & Shabani, 2018).

As part of their findings, Yang *et al.* (2018) suggest that supply chain learning influences SCDCs and sustainable SCP. Moreover, a recent study by Singh and El-Kassar (2018) used green training along with green human resource management (GHRM) to investigate the degree to which green human resource management practices influence the integration of big data technologies. The study found that building organisational capabilities requires GT. Similarly, using SEM, in a context of vocational education schools in hospitality and tourism in Spain, Hidalgo-Peñate, Padrón-Robaina and Nieves (2019) found that the acquisition of knowledge through training enhances DCs. Finally, a recent study by Ogbeibu *et al.* (2019) which examined the roles of technological turbulence and environmental DCs also indicated that technological turbulence, green recruitment and selection and green training involvement and development are positive predictors of product innovation through green team creativity. From the DCT's perspective, GT plays dual roles, which consist of affecting the creation, development and improvement of distinctive competencies and helping firms to achieve organisational performance. Accordingly, the study predicts that:

H_7: Green training (GT) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

4.6 PROPOSED RELATIONSHIP BETWEEN SUPPLY CHAIN DYNAMIC CAPABILITY AND SUPPLY CHAIN PERFORMANCE

Firms need SCNs that can respond adequately and adjust their competencies to meet the requirements of business environments (Aslam *et al*. 2018). Thus, identifying new strategic resources in the ever-changing markets and combining them with existing resources enhance the performance of the SCN (Jin & Edmunds, 2015; Lee & Rha, 2016). Some research on DCs has shown their effects on SCP (Cheng *et al.*, 2014; Jin & Edmunds, 2015; Lee & Rha, 2016; Rojo *et al.*, 2017; Aslam *et al.*, 2018; Jajja *et al.*, 2018; Rajaguru & Matanda, 2018; Irfan & Wang, 2019). However, conflicting reports are suggesting that SCDC does would not necessarily lead to SCP if they are not stable and reliable. Such studies include Giniuniene and Jurksiene (2015), Liao *et al.* (2017); Teece (2018) and Gölgeci *et al*. (2019).

4.6.1 Supply chain dynamic capabilities and supply chain agility

The eighth hypothesis in Figure 4.1 (H8) involves the positive influence SCDC may have on SCA. Several studies have examined the relationship between SCDC and SCA. Such works include L'Hermitte *et al*. (2015), Sangari and Razmi (2015), Mandal *et al.* (2017), Jajja *et al.* (2018), Mandal (2018) and Aslam *et al.* (2020). SCA can be defined as the ability to adjust and adapt strategies and competencies timeously to respond to changes in the supply chain (Mandal, 2018; Gölgeci *et al.*, 2019; Aslam *et al.*, 2020). Lima-Junior and Carpinetti (2017) report that SCA is characterised by the rapid response at the time of uncertainty through adequate capacity in terms of resources, flexible scheduling, timeously decision making and delivery, while Geyi *et al.* (2019) perceive SCA as the ability to adapt to customer requirements while minimising the risk of disruptions. From these definitions, it can be observed that changes outside the firm sphere, which occur at a swift pace, trigger a suitable response strategy to ensure that organisational objectives are met (i.e. customer satisfaction).

With the increased level of competition as well as the rising market uncertainties, SCA has been identified as a key element to successfully compete in dynamic environments (Sangari & Razmi, 2015). For example, H&M, Zara and Walmart have incorporated agility into every corner of their supply chain to guarantee responsiveness to dynamic supply and demand through modular design processes, agile manufacturing and improved inventory management technologies (Irfan *et al.*, 2019). Sangari and Razmi (2015) stress that SCA is built around two main components, which include the identification of market changes and the development of suitable response measures (i.e. ability to reconfigure and deploy resources) to tackle changes. SCA enables members of the supply chain to make timely decisions of supply chain-related matters which include delivery delays, unsatisfied customers and lead time, among others (Lee & Rha, 2016).

The relationship that links SCDC with SCA can be understood through a competence-capability relationship paradigm. This says that SCA is considered externally focussed (i.e. customers) through supply chain competencies, while DC is internally oriented (i.e. firm-specific resources) and is viewed as the antecedent of SCA capabilities (Sangari & Razmi, 2015; Irfan *et al.*, 2019). Moreover, Irfan *et al.* (2019) stress that SCA is realised downstream the supply chain through customer effectiveness in dealing with supply chain complexities. SCA requires that firms develop and deploy resources to create capabilities needed to overcome supply chain challenges and provide sustainable competitive advantage through SCP (L'Hermitte *et al.*, 2015; Mandal *et al.*, 2017). Moreover, SCA is developed through SCDC in response to contingencies that arise as a result of market volatility (Mandal *et al.*, 2017).

The interlink between SCDC and SCA has been widely discussed in the literature. For example, a study by Jajja *et al.* (2018) used DCT to explain why supply chain risk may motivate companies to integrate their supply chain to enhance agility performance. The findings show that supply chain integrating through DC has a positive impact on agility performance. Using the structural equation modelling to analyse data collected from Iranian manufacturers in the automotive industry, a study by Sangari and Razmi

(2015) revealed that business intelligence competencies through SCDC enable SCA. As part of their finding, Lee and Rha (2016) also posit that SCA is positively affected by SCDCs, while Irfan *et al.* (2019) argue that SCDC through process integration enables SCA. SCA depends mainly upon the technological ability of the firm to respond timeously to market demands for a greater SCP (Bag et al*.* 2018). Therefore, the study proposes SCDCs enable SCA by helping firms to sense, seize and respond effectively and efficiently to market demands. The study hypothesises:

H_8: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain agility (SCA) in the South African manufacturing sector.

4.6.2 Supply chain dynamic capabilities and supply chain reliability

The ninth hypothesis in Figure 4.1 (H9) involves the positive influence SCDC may have on SCREL. SCREL is described as the ability of firms to perform tasks as expected and under specified conditions (Geyi *et al*., 2019; Lima-Junior & Carpinetti, 2019; Zhang *et al.*, 2020). Zhang *et al.* (2019) define SCREL in the context of construction as the ability to deliver capital projects within the specified time, budget and quality despite uncertainties in the supply chain and to ensure that projects meet environmental sustainability through green technology. From these definitions, one can observe that SCREL promotes consistency in supply chain operations; shipments/projects must be delivered on time and to the right customers as well as meet order specifications. It is important to stress that SCREL is one of various characteristics that measure performances and provides useful theoretical insights to quantify risks and uncertainties in the SCNs (Zhang *et al.*, 2019).

Supply chain reliability is an underlying requirement for SCNs since it represents the first step towards improving supply chain operations and mitigating supply chain risks through the lens of strategic capabilities (Lu *et al.*, 2016). For example, using SCOR metrics to evaluate the SCP, Lu *et al.* (2016) found that SCREL is one of the critical operational criteria to assess the performance of the supply chain. Moreover, Zhang *et al.* (2020) postulate that SCREL plays the role of defining the probability of meeting customer requirements within conditions of time, quantity and quality. Zhang *et al.* (2020) further stress that these factors are required to measure and determine the level of customer satisfaction as well as to set room for potential improvements. Additionally, SCREL is viewed as a central instrument to evaluate order fulfilments, the percentage of orders delivered in full, the timeliness of deliveries to customers, the documentation accuracy and the undamaged state of products. The main objective of these evaluation criteria is to ensure deliverables meet customer requirements and risks are mitigated in a way that ensures firms' readiness to tackle supply chain issues (Lu *et al.* 2016). SCREL helps improve performance through collaboration and cooperation, which in turn help to leverage resources and capabilities, resulting in higher performance (Fernando *et al.*, 2018).

Empirical evidence and observations have reported in several research studies the relationship between SCDC and SCREL. For example, under the lens of strategic capabilities, Vishnu *et al*. (2019) developed measurement systems to evaluate the performance of the supply chain using reliability and other supply chain attributes. Sawyerr and Harrison (2019) suggested that collaboration with partners, top management commitment, human resource management and redundancy (i.e. backing up of all critical operational components, skills among others) are essential elements to achieve SCREL through supply chain resilience (i.e. ability to transform, learn and innovate). Zhang *et al.* (2019) evaluated the SCP through reliability using an integrated model of building information modelling (BIM)-lean supply chain (LSC) and found that BIM-LSC influence SCREL and induce greater confidence to project teams. Fernando *et al.* (2018) used big data analytics (BDA) to measure SCREL along with other SCP attributes and found that BDA are positively related to service reliability. These views provide enough evidence regarding the intertwining behaviour of SCDC and SCREL. Based on these arguments, the study hypothesises:

H_9: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain reliability (SCREL) in the South African manufacturing sector.

4.6.3 Supply chain dynamic capabilities and supply chain costs

The tenth hypothesis in Figure 4.1 (H10) relates to the positive influence SCDC may have on SCC. SCCs represent expenses incurred in operating supply chain processes and include labour costs, material costs, management and transportation costs (Lima-Junior & Carpinetti, 2019). From the SCOR metrics perspective, SCC is described as costs associated with operating the supply chain (Lu *et al.*, 2016). The high level of competitiveness in high-velocity markets has forced manufacturing firms to start competing on cost efficiency and flexibility since the ability to use resources more efficiently provides price benefits (Jiang *et al.*, 2015). Brandon-Jones and Knoppen (2017) posit that the cost dimension is one of the most distinct SCP indicators of operational capabilities and includes purchasing prices and cost of purchasing processes. Furthermore, it is suggested that low-cost structure allows firms to provide its customers with better value for their money (Geyi *et al*., 2019). Thus, assessing SCC is an important exercise since it allows firms to separate value-added activities from non-value-added activities, identify costs associated with these activities as well as their drivers (Jiang *et al.*, 2015; Maiga, 2017).

In addition, the information resulting from assessments of the supply chain allows managers to design products and processes that consume fewer resources, enhance the efficiency of existing activities, improve coordination with customers, suppliers and partners (Maiga, 2017; Chen, 2018; Lu *et al.*, 2020). Moreover, Chen (2018) and Lu *et al.* (2020) stress that integrating supply chains helps build trust and confidence among members and provides supply chain benefits which include, knowledge transfer, joint learning, risk sharing and cost minimisation associated with the exploitation and the exploration of opportunities. An effective and efficient supply chain will reduce inventory costs and allow to forecast more accurately to meet market demands; hence it is required to develop resources and capabilities that will enable firms to compete in dynamic environments (Ju *et al.*, 2016).

Technological development and innovation through the lens of DC provide substantial benefits such as quality and flexibility, reduced lead time and improved SCC, thus enhancing the overall SCP (Jiang *et al.*, 2015; Feng *et al.*, 2016; Ju *et al.*, 2016). Additionally, Ju *et al.* (2016) ascertain that a positive supply chain collaboration and cooperation with suppliers and partners promote supply chain efficiency through cost reduction. Aslam and Azhar (2018) suggest that DC provides a competitive advantage by improving operational costs through the agility of SCNs, while Brandon-Jones and Knoppen (2017) posit that the effective development of purchasing activities under the lens of SCDC within an SCN generates improvements in cost and innovation. In this sense, the combination of cost and innovation performances is the result of knowledge resources. Moreover, using resources more efficiently through DC improves SCC and product innovation. Lu et al. (2020) in their study targeting SMEs in China, reported that SMEs with better supply chain integration strategies develop lower cost structure, which in turn results in competitive advantage through an improved SCP.

Some studies have investigated the interlink between SCDC and SCC to determine how the interaction between these two variables affects operational performances. For example, building on DC, Maiga (2017) conceptualised a manufacturing plant operational performance along with improvements in cost, quality and cycle-time. The study investigated the interactive effects of activity-based-cost (ABC), internal information systems integration (IISI) and external information systems integration (EISI) on manufacturing performance. The results indicate that all three capabilities (ABC, IISI, EISI) significantly improve operational performance through cost, quality and cycle time. Furthermore, as part of their research findings, Ju *et al.* (2016) stressed that SCDC positively impacts technological innovation and operational performance, which includes SCC. Similar results were found by Feng *et al.* (2016), who argued that guanxi and SCI positively influence operational performance through costs and other performance indicators.

In addition, sharing information and collaborating with suppliers and partners influence process and product innovation and improve cost, flexibility, quality and delivery. Moreover, Chen (2018) demonstrated that both IT integration and trust in supply chain significantly enhance supply chain agility and innovativeness, which in turn positively affect a firm's competitive advantage. The results indicate that IT integration and trust are antecedents for improving supply chain agility, which includes SCC and innovativeness. Therefore, the current study argues that when firms possess strong SCDCs which include technologies, integration strategies, human capital, they can achieve superior SCP through SCC. Accordingly, hypothesis (H_{10}) is as follows:

H_{10}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain costs (SCCs) in the South African manufacturing sector.

4.6.4 Supply chain dynamic capability and supply chain responsiveness

The eleventh hypothesis in Figure 4.1 explicitly states the positive influence SCDC may have on SCR. Giannakis and Louis (2016) and Giannakis *et al.* (2019) define responsiveness as the firm's ability to respond to market demands without distortions or delays. Odongo *et al.* (2017) also define SCR as the speed in which product requests are resolved resulting in customer satisfaction; while Kilubi and Rogers (2018) describe SCR as the ability to learn new skills and adapt them in reaction and anticipation of market developments. From these three definitions, it is perceived that

SCR encompasses the level of flexibility in which supply chain activities are performed and the rapid response to their uncertainties to achieve a better supply chain outcome. The increased level of complexities in SCNs has prompted firms to develop effective measures to mitigate the effects of supply chain uncertainties (Giannakis & Louis, 2016). Giannakis and Louis (2016) and Giannakis *et al*. (2019) characterise responsiveness into three categories, which include the visibility of information that allows firms to share information with supply chain members and sense market developments, the rapid detection and reaction to supply chain risks and finally, the speed in which products and services are delivered to customers.

Supply chain responsiveness enables firms to make timely decisions to effectively tackle supply chain uncertainties such as delivery delays, unsatisfied customers and lead time problems (Lee & Rha, 2016; Kilubi & Rogers, 2018; Song & Liao, 2018; Giannakis *et al.*, 2019). To resolve these concerns, firms must develop within their supply chain competitive factors such as responsiveness and flexibility to better compete in dynamic environments and deliver products and services that meet the customer requirements (Kilubi & Rogers, 2018). Meeting customer requirements and fulfilling orders without any form of distortions and latencies is an indication of the effectiveness and successful implementation of supply chain activities (Giannakis *et al.*, 2019). The key features of SCR concern its ability to deal with supply chain conflicts in effective strategic decisions to respond the market uncertainties, which include competitor strategies and consumer needs, among others (Chen, 2018; Yu *et al.*, 2019). Ahmed *et al*., (2019) and Yu *et al.* (2019) argue that SCR allows firms to respond timeously and adequately to market demands by developing new products/services or adjusting their supply chain operations to match the ever-changing market conditions.

The core capabilities of any given firm reside in its ability to respond effectively to market changes. There is a plethora of strategies that allow firms to tackle market volatilities, which include building an interdependent supply chain as it will enable supply chain members to generate innovative capabilities that can help to achieve SCR (Chen, 2018; Singhry & Rahman, 2018). Moreover, developing an interactive network among members of the supply chain is beneficial in the sense that it fosters collaboration and innovative development (Chen, 2018). Singhry and Rahman (2018) argue that collaborative forecasting decreases inventory costs and improves SCR. For example, Bag *et al.* (2018) argue that focal firms that develop a collaborative network with their suppliers are found to have a higher level of flexibility and capability to manage a dynamic environment as well enhanced responsiveness. Moreover, information technology allows supply chain members to share information in real-time, which is essential to improve speed, flexibility and responsiveness (Chen, 2018; Mandal, 2018; Ahmed *et al.*, 2019). In support of this view, Kumar and Singh (2016) observe that information systems and business operations are tightly integrated, and their combination improves the SCR. Again, the study emphasises that innovative capabilities, collaboration and cooperation are essential components of SCDC's rationale to drive SCP.

Numerous studies have examined the link between SCDC and SCR. For example, a study by Kilubi and Rogers (2018) suggests that strategic technology partnering (STP) capabilities have a positive influence on organisational performance through flexibility and responsiveness. The study argues that possessing STP capabilities provides higher performance through better flexibility and responsiveness in the SCN. Giannakis *et al.* (2019) provide a comprehensive analysis of cloud-based computing capabilities and found that they improve operational performance through SCR. Furthermore, Singhry and Rahman (2018) examined the antecedence of SCP through collaborative planning, forecasting and replenishment (CPFR) and supply chain innovation capability (SCIC). The study reported that SCIC significantly affects SCP through responsiveness, efficiency and market performance. Based on these views, the current research argues that supply chain risks are spread across the entire supply chain; therefore, it is important to develop joint competencies through SCDCs that can allow firms to respond to uncertainties effectively. Thus, the study hypotheses:

H_{11}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain responsiveness (SCR) in the South African manufacturing sector.

4.6.5 Supply chain dynamic capabilities and supply chain quality

The twelfth hypothesis in Figure 4.1 (H12) deals with the positive influence SCDC may have on SCQ. The advent of competition has shifted the traditional product quality to the full SCQ performance (Li *et al.*, 2019). It is important to note that the quality of products and services in markets does not only depend on the quality effort of a single firm but mainly on the combined efforts of supply chain members to achieve SCP through SCQ (Yu & Huo, 2018; Li *et al.*, 2019). Buyers and suppliers must ensure that quality is included in all stages of supply chain activities to produce products of acceptable quality (Yang *et al.*, 2019). Product quality refers to a product's attributes that guarantee safety, attractiveness and environmentally friendly features (Odongo *et al.*, 2017). SCQ refers to the ability to deliver on quality requirements, which include safety and product quality (Geyi *et al.*, 2019). A close observation of these definitions shows the inclusion of different elements. The first element concerns the quality of the process to maintain consistency and standard. In this sense, Li *et al.* (2019) describe quality as a systematic process to evaluate, control and improve the overall performance. The second element concerns the collaboration, cooperation and coordination among supply chain members to achieve SCQ. The third element is concerned with the product attributes that meet order or customer requirements, which in turn results in customer satisfaction.

Quality plays an important role in enforcing the credibility and image of firms. Most importantly, quality has always been at the core of competitiveness. Thus, firms must strive to improve all quality-related activities in the supply chain to enhance products' quality as well as customer loyalty, brand and market share (Yu *et al.*, 2017; Yu & Huo, 2018). Alkalha *et al.* (2019), in their study, demonstrate the importance of quality and highlight the fact that most product recall issues are due to poor quality (i.e. raw materials, incorrect packaging, product contaminations, products not functioning as expected, among others); hence, all stakeholders at different stages of their operations and throughout the entire SCN must ensure full compliance with the spelt specifications and standards to achieve higher performance through SCQ. Moreover, Yu and Huo (2018) affirm that the need to compete effectively has forced focal firms to start integrating suppliers and customers into their SCNs to achieve a better SCP through SCQ. Supply chain integration fosters organisational learning, sharing of essential resources to deliver high quality-related performance at low costs (Yu & Huo, 2018). Coordinating a design of high-quality products in the supply chain requires members of the SCN to comply with the number of demands in terms of unit price and delivery schedule (Alkalha *et al.*, 2019). Arguably, in this dynamic environment full of uncertainties, the success of the SCN can be achieved under the lens of SCDC through transparency and effective cooperation and coordination with suppliers and consumers.

Collaboration and coordination among members of the supply chain help decrease costs through decreased inventory and shorter cycle times, improved quality through better design for manufacturability and fast delivery (Singh, 2015; Huo *et al.*, 2016). Singh (2015) further stresses that firms need to maintain a high level of competency by strengthening strategies such as short lead-time, Just-in-time control, stable demands and quality to achieve a sustainable SCP. Information sharing and supply chain integration can improve SCQ (Huo *et al.*, 2016; Yang *et al.*, 2019). Huo *et al*. (2016) emphasise that information sharing enables supply chain members to have a clear knowledge about the levels of inventory and the needs of customers. Hence, they can replenish their stocks promptly and deliver the right products to the right customers, which in turn, results in improved SCQ.

Only a few studies have confirmed the positive effect of SCDC on SCQ. For example, as part of their research findings and in the light of DC, Huo *et al.* (2016) posit that supply chain information integration positively affects operational performance through quality. Building on DC, Maiga (2017) postulates that an appropriate configuration of ABC and IT capabilities improve operational performance through quality and other performance attributes. A study by Yang *et al.* (2019) argues that a collaborative buyer-supplier relationship significantly improves SCQ through efficient processes and effective interaction with customers; while Alkalha *et al.* (2019) posit that absorption capability (AC) improves SCQ. The authors argue that AC enables firms to design quality and continuously improve product and process development for the benefit of supply chain members. These studies shed light on the importance of SCDC in achieving SCP through SCQ. Therefore, based on these observations, the study hypothesises:

H_{12}: Supply chain dynamic capabilities (SCDCs) exert positive influence on supply chain quality (SCQ) in the South African manufacturing sector.

4.6.6 Supply chain dynamic capabilities and supply chain balance

The last and thirteenth hypothesis in Figure 4.1 (H13) relates to the positive influence SCDC may have on SCB. SCB refers to a distribution of risks and benefits across the SCN (Odongo *et al.*, 2017). An analysis of the definition shows an element of the relationship that is built among supply chain members to create mutual opportunities and goals, aiming to improve the overall supply chain. This relationship is based on trust and includes the active participation of supply chain members in sharing resources, distributing risks and benefits. SCB, in its essence, follows the rationale of social networking and social capital theories which advocate that firms cannot function in isolation. They instead need to develop a supportive supply chain structure that facilitates the transfer, the exchange of knowledge and skills, experience and technologies for better and balanced performance (Oparaocha, 2015; Petricevic & Verbeke, 2019). For example, Pratono (2018) argues that the social networking that gives rise to social capital provides information, influence and solidarity, which rest in the ability of supplier chain members to deploy their resources and capabilities with goodwill for the benefit of the supply chain. Petricevic and Verbeke (2019) argue that innovation is the result of inter-firm cooperation and coordination, whether through a specific strategic alliance or a broader networking relationship.

Dynamic capability theory postulates that firms can achieve evolutionary fitness with their outside environment by matching the changes as well as the nature of their relationships with supply chain members for an enhanced and balanced SCP (Petricevic & Verbeke, 2019). From a networking perspective, Casanueva *et al.* (2015) stress that in order to develop SCDCs, firms need to collaborate and cooperate with other entities since building trust is necessary to achieve an efficient and balanced SCP. Moreover, Oparaocha (2015) argues that collaboration and knowledge sharing actuate innovative capabilities, which in turn promote SCP; while Trkman *et al.* (2015) ascertain that an effective collaboration includes sharing resources which can help develop both the ability and willingness to change business models while keeping the balance between the need to adapt to market demands and the need to standardise practices across the entire supply chain for improved performance. The standardisation of practices in the supply chain allows supply chain members to understand their roles and responsibilities, understand each other’s interests as well as their products and processes, resulting in a more equilibrated and balanced supply chain (Odongo *et al.*, 2017). Furthermore, Mandal (2017) posits that the supply chain is better off when capabilities and vulnerabilities are spread across the SCN. This allows members of the supply chain to develop effective control mechanisms that improve their capabilities, which in turn lead to a more balanced supply chain (Mandal, 2017).

Several studies empirically tested the influence of supply chain relationships on SCP. For example, Odongo *et al.* (2017) identified a positive influence of supply chain relationships on SCP through efficiency, responsiveness, quality and SCB. A balanced SCN promotes a supply chain atmosphere conducive for collaboration and cooperation while mitigating risks and opportunism (Mitrega *et al.*, 2016; Riley *et al.*, 2016). Riley *et al.* (2016) further argue that risks affect the equilibrium of the supply chain, which is detrimental to respond to market demands and achieve superior performance adequately. Mitrega *et al.* (2016) investigated the concept of networking capability (NC) for the management of supplier relationships and their dynamics to leverage product innovations. The study found a positive relationship between NC and product innovation, which results in greater SCP. In addition, the relationship proclivity amplifies the effect of NC on product innovation for a better SCP. A study by Revilla and Knoppen (2015) found that integrative mechanisms, joint decision-making and joint sense-making affect the performance of the supply chain in many ways, which include creating a balanced supply chain network. Based on these arguments, the study posits that the intra- and inter-firm social networking paradigm is at the centre of SCB, which is driven by SCDC; therefore, the study hypothesises:

H_{13}: Supply chain dynamic capabilities (SCDCs) exert a positive influence on supply chain balance (SCB) in the South African manufacturing sector.

4.7 AUTHOR’S IDEAS AND ANALYSIS

The current study recognised dynamic capabilities as a combination of three dimensions which include: adaptative capability, which entails taking advantage of opportunities that arise in the supply chains; absorptive capacity, which represents the ability of a firm to collaborate, integrate, coordinate and exploit information from business intelligence for commercial purposes; and innovative capability, which refers to the ability to generate new competencies resulting in product development and processes (i.e. green production). All three dimensions are grouped into a single construct called supply chain dynamic capabilities. These capabilities have to be developed and integrated in a way that allows manufacturing firms to meet their strategic objectives. It is important for manufacturers to assess their resources and capabilities in order to detect areas of improvements and take rapid and swift actions to mitigate risks. The assessment may include supply chain processes and operations, skill development, and equipment and technology used to create services or products. This will allow companies to timeously tackle challenges they face by providing adequate training and forecast future needs. This view is echoed by Mousavi et al. (2018) who stress that DCs represent an accumulation of experiences and routine activities through which firms achieve new configurations and competencies as a result of continuous assessment.

Supply chain performance describes a systematic process of assessing supply chain activities to determine the effectiveness and efficiency of the supply chain network (Sundram et al., 2016). It is important to note that there is no single way of assessing the performance of the supply chain and there is no consensus on the performance measures. This is a clear demonstration of the lack of integrated performance evaluation systems. The present study measures supply chain performance in terms for supply chain agility, supply chain reliability, supply chain costs, supply chain responsiveness, supply chain quality and supply chain balance. Supply chain agility for example here denotes the ability to adapt to customer requirements while minimising the risk of disruptions. The Covid-19 pandemic and the current war in Ukraine have disrupted and really exposed the vulnerability of the global supply chain. It becomes paramount that firms constantly assess their supply chains and develop measures that can allow them to mitigate risk and respond adequately to customer demands. An effective evaluation of the supply chain can add value to the supply chains and help achieve organisational objectives.

4.8 CHAPTER SUMMARY

The purpose of this chapter was to discuss SCDCs and SCP, provide an explanatory theoretical framework of GSCMPs and SCDC that translates to higher SCP and develop research hypotheses. Section 4.2 of the chapter discussed SCDCs and reported that it is important for manufacturing firms to develop SCDCs as they enable them to upgrade their ordinary capabilities while sensing and seizing new opportunities to improve their SCP. The chapter also noted that there had been some debates around the origin, nature and the concept of DC, which make it difficult for practitioners and scholars to develop a common conceptual framework. Section 4.3 discussed the performance of the supply chain and emphasised the importance and need to measure the performance of the SCN since the evaluation allows firms to add value to their networks through better decision-making processes. The SCP in the current chapter is measured in terms of agility, reliability, costs, responsiveness, quality and balance. Section 4.4 illustrated the theoretical model that guided the present study and offered some insights into enablers and mediators of GSCMPs and the resultants of SCP. The chapter finally developed hypotheses and discussed their relationships between the research constructs. The next chapter discusses the research methodology.

CHAPTER 5

RESEARCH METHODOLOGY

5.1 INTRODUCTION

The aim of this chapter is to discuss in detail the research methodology that was used to investigate the effects of the relationships between GSCMPs, DCs and SCP in the South African manufacturing sector. The research process consisted of collecting, compiling, analysing and interpreting data from a sample drawn from the target population to provide a meaningful outcome that could be used by decision makers to take optimum decisions for their organisations. The chapter first outlines the context underlining the research theoretical approach and then explains the research paradigms to elaborate on the study's philosophical orientation. It further discusses and provides details surrounding the adoption of the research approach, research designs and research strategy. Moreover, it provides a description of the literature review since it forms part of the research design of the study, supported by its importance in empirical studies. It further discusses the empirical research part of the study involving the sampling design methods for dealing with data related problems and procedures for data analysis. Additionally, it discusses the various tests for normality of the collected data, discusses descriptive and inferential statistics, exploratory factor analysis as well as the structural equation modelling (SEM). The chapter then describes the ethical considerations related to this project and closes with a chapter summary.

5.2 RESEARCH REASONING

Research reasoning represents one of the basic forms of stimulated thinking as well as a process of deducing new judgements (conclusions) from one or several existing judgements (premises) (Chen *et al.*, 2019:2). Leedy and Ormrod (2015) also describe research reasoning as a process of thinking logically that allows the researcher to identify, analyse and evaluate the data collected from the target population to see whether they support the formulated hypotheses and resolve the question that prompted the research endeavour. The importance of research reasoning is recognised because it influences research design and facilitates the creative drive that makes discoveries possible (Saunders *et al.*, 2015). Several scholars (Blumberg *et al.*, 2014; Saunders *et al*., 2015) identify three approaches to theory development, which include deductive reasoning, inductive reasoning and abductive reasoning. Deductive reasoning describes a form of logic that aims to guarantee the truth of the conclusion if the premise of the argument is observed to be true (Dong *et al.*, 2015). Additionally, deductive reasoning requires a stronger link between reasons and conclusions, which implies that it occurs when the conclusion is derived logically from a set of premises, the conclusion being true when all the premises are true (Saunders *et al*., 2015). Conversely, inductive reasoning denotes drawing a conclusive statement from one or more particular facts or pieces of evidence (Blumberg *et al*., 2014). Dong *et al*. (2015) also describe inductive reasoning as a process of accumulating evidence to support or disprove a conclusion. This approach is often associated with qualitative studies and advocates that the conclusions are only probable rather than true as a matter of necessity (Folger & Stein, 2017).

The third reasoning approach is characterised as abductive reasoning approach which is a combination of deductive and inductive reasonings and represents a process of inference that yields the best explanation to a course of events (Cramer-Petersen *et al.*, 2019). In other words, an abductive approach represents a preliminary estimate that introduces plausible hypotheses and informs where to first enquire by choosing the best approach among a variety of possible explanations.

Given that the current study wishes to establish a causal relationship between GSCMPs, DCs and SCP, it adopted a deductive reasoning approach. Hypotheses that were developed from existing theories and presented in Chapter 4 were tested against data that were collected from research respondents through online survey questionnaires to determine, support or refute the existence of significant links between research constructs as predicted in the literature. Moreover, deductive reasoning allowed the study to anticipate the possibility of enhancement of the SCP through the adoption of GSCMPs under the mediation of DCs and permitted the verification of the theory.

5.3 RESEARCH PARADIGMS

Paradigms derived from ancient Greek philosophers and imply models, frameworks, or patterns with a distinctive set of concepts or thought patterns that include theories, research methods and standards for scientific practices (Sefotho, 2018). Scholars such as Frey (2018) and Sefotho (2018) define research paradigm as a comprehensive framework that guides a research project and best practices in the field of interest. It is important to note that research paradigm plays a crucial role in guiding a research process that pursues a particular route. A number of authors classify research paradigms' dimensions differently. For instance, research paradigms include post positivism (Ellingson, 2018), positivism (Blumberg *et al*., 2014; Ellingson, 2018; Sefotho, 2018), phenomenology (Leedy & Ormrod, 2015), interpretivism (Blumberg *et al*. 2014; Sefotho, 2018), realism (Blumberg *et al*. 2014) and pragmatism (Lopes, 2015; Frey, 2018), among others. The current study briefly discusses the commonly used research paradigms in business scientific fields such as positivism, post positivism, phenomenology and pragmatism.

The positivism paradigm seeks to apply the natural science model to investigate social phenomena (Ellingson, 2018). It focusses on generating pure truths about an external, discoverable world that can be measured accurately with the primary goals of prediction and control. Positivism is generally aligned with quantitative studies and its basic premises rest heavily on measurements, causality and objectivity (Blumberg *et al*., 2014; Ellingson, 2018). Post positivists acknowledge that a pure truth which is unaffected by factors is impossible. This includes, for instance, the culture, the language and the human cognition. This paradigm maintains that the ultimate goal of a research project is to reduce the research bias whenever possible (Ellingson, 2018).

Phenomenology on its part refers to a person's perception regarding the meaning of an event. In other words, phenomenological studies attempt to understand people's perceptions and perspectives relative to a particular context (Leedy & Ormrod, 2015). This type of paradigm is generally associated with qualitative research projects. Moreover, the pragmatism paradigm postulates that there is no single way of interpreting the world and undertaking a research project. It recognises the merits and demerits of each research method and allows the researcher to select the method that is suitable to answer research questions (Lopes, 2015; Frey, 2018). As such, pragmatists encourage the use of a variety of methods to answer research questions that cannot be answered with a single method. This type of research advocates for the use of mixed methods (Frey, 2018).

It is important to stress that a deductive approach to reasoning discussed in Section 5.2 is rooted in the positivism paradigm. Therefore, based on this logic, the current study was oriented towards the positivism paradigm. The positivism paradigm provides suitable scientific tools (i.e. confirmatory analysis [CFA], SEM, among others) to objectively measure the cause-and-effect relationships since it is established on the ontological principle and doctrine that truth and reality are free and independent from the researcher's view (Ellingson, 2018). This statement allows the researcher to argue that using appropriate scientific research methods can help to determine the real relationships between the variables under investigation in this study. In addition, positivism paradigm has the ability to define the foundation of empirically testable data and make certain statements based on observations from which absolute laws of social behaviour may be attained (UKEssays, 2018; Little, 2019). This particularity allowed the study to scientifically verify the truth through empirical observations and logical analysis of the relationships between GSCMPs, SCDCs and SCP in the South African manufacturing sector. If throughout the verification process, the facts deemed to be objective hold on to hypotheses developed from the literature, then the fundamental laws and principles applied, and the validity is therefore enforced.

However, it is important to note that empirical evidence deriving from data analysis does not always get closer to the truth or reality but moves away from the paradigm that is unable to guide normal science (Marcum, 2019). In addition, Marcum, (2019) further rejected the logical positivist's verification principle in terms of objective and mind-independent language. Instead, scientific terms and concepts, with respect to their meaning, are relative to a conceptual framework. Because of such relativity, no theory could be completely verified, as testified by the history of science in that no theory has stood the test of time. Although positivism encourages researchers to disregard human emotion and behaviour, there is no guarantee that this did not occur during the study. Therefore, the results of the current study should be generalised carefully across the South African manufacturing sector and internationally.

For this study, the researcher's philosophical assumptions on ontology (reality), epistemology (knowledge creation), and methodology were critical in framing the research process. It is important to note that the positivism paradigm makes assumption about the nature of reality, how knowledge is created and assumes that the values the researcher brings to the selection of methods, respondents, data collection and analysis, and interpretation of results influence the research process (Klenke, 2016; Cruickshank, 2020). On this view, since no knowledge can derive from the vacuum, one ought to say scientific knowledge accounts for the causal relationship between variables of interest in this study. The epistemology helped examine how the researcher created knowledge through ontological basis about modelling the relationship between GSCM practices, SCDCs and SCP in the South African manufacturing sector. The outcome of the analysis (cause and effect) can be considered as knowledge generated because the study followed some form of methods that, systematically can ensure the truth.

The use of a positivist paradigm in the current study is also anchored on the use of the same philosophy in several previous studies in SCM. For instance, consideration was given to the work of Falguieres *et al.* (2015) who used the positivism paradigm to test hypotheses explaining the relationships between emigration, the launch of the short food supply chain business and unemployment. Another study by Magutu *et al.* (2015) determined the extent to which supply chain technology moderates the relationship between supply chain strategies and performance of large-scale manufacturing firms in Kenya. Moreover, the positivism paradigm guided the data analysis of a study by Zhang *et al.* (2017) which examined the effects of mass customisation and product modularity on supply chain quality integration (i.e. internal, supplier and customer quality integration) and the impact of supply chain quality integration on competitive performance. Similarly, Geyi *et al.* (2019) investigated the relationships between agility and sustainability and their impact on sustainability performances of UK manufacturing industries. These pieces of evidence demonstrate the role the positivism paradigm plays in facilitating the research process through empirical verifications and explanations of the relationships between research constructs within SCM. Hence, the present study assumed the same paradigm.

5.4 RESEARCH APPROACHES

Research approaches (also known as research methods) represent effective measures that allow the collection of the necessary information for a research project for analysis and interpretation (Creswell, 2014). Several authors (Creswell, 2014); Leedy & Ormrod, 2015; Creswell & Creswell, 2017) identify three approaches to research endeavour that allow the collection of specific information required to answer research questions. These approaches (methods) to research include qualitative, quantitative and mixed methods. Qualitative research methods follow an inductive reasoning path and facilitate the exploration and understanding of the meaning of the phenomenon under investigation. This suggests that a qualitative research process uses a less structured questionnaire than quantitative research and involves collecting data through interviews, analysing them inductively and making interpretation of their meaning (Creswell & Creswell, 2017). In contrast, quantitative research is more structured and mainly relies on collecting and analysing numerical data. It places emphasis on empirical inquiry to understand phenomena under investigation (Frey, 2018). Finally, a mixed method provides a more complete understanding of the phenomenon of interest since it involves collecting both qualitative and quantitative data, interpreting them and using distinctive designs that may involve philosophical assumptions and theoretical frameworks (Creswell & Creswell, 2017).

The present study was quantitative since it aimed to investigate and explain the relationships between research constructs under consideration. Quantitative studies have the characteristic of reducing explanations of the relationships to simple general guidelines and rules. Most importantly, a quantitative approach allows deductive methods such as hypothesis testing to be used. Additionally, a quantitative method is recognised by its ability to objectively measure the variables of interest, hence guaranteeing the neutrality of the researcher as the research is guided by empirical evidence obtained from a systematic process. It is also important to stress that this approach to inquiry ensures the reliability and validity of the research through accuracy and precision of the measurements. Furthermore, the results of the study may be repeated in subsequent research projects and the findings may be considered for generalisation across the South African manufacturing sector.

A number of previous studies on GSCM used quantitative approach. For instance, Mafini and Muposhi (2017) used a quantitative approach to examine the association between GSCMPs, environmental collaboration and financial performance in South African SMEs. Choudhary and Sangwan (2018) used a quantitative method to analyse the impact of GSCM pressures, the implementation of GSCMPs and the improvement in performance of Indian ceramic enterprises. Ghosh (2019) used the quantitative method to identify the factors influencing the adoption of green procurement (GP) in Indian firms. The same author also investigated the influence of GP on the corporate performance. Finally, Çankaya and Sezen (2019) investigated the influence of GSCM on environmental, economic and social performance. Quantitative data were collected from Turkish manufacturers for analysis. These studies serve as evidence that quantitative approaches have been widely used in the field of GSCM. This further motivated its applicability to the present study.

5.5 RESEARCH DESIGN

Research design can be defined as a framework or blueprint for conducting a business research project in an efficient manner. It details the procedures necessary for collection, measurement and analysis of information that enables the structuring or solving of business research problems (Sreejesh *et al.*, 2014: 27). Sreejesh *et al*. (2014) classify quantitative research into exploratory, descriptive and causal designs. Leedy and Ormrod (2015) categorise them as observation, correlational, developmental and survey designs. Creswell and Creswell (2017) label them as experimental, causal-comparative, survey and correlational designs. Moreover, Frey (2018) classifies quantitative research designs into two categories, namely experimental and non-experimental (causal-comparative and correlation designs). Since there is no unanimity in classifying quantitative research designs in research literature, the current study selected and briefly discussed four designs which include, experimental, correlational, survey and causal comparative. This choice was motivated by the fact that these four designs commonly appear in each of the above classifications developed by different scholars.

The first research design mentioned is labelled experimental design, which is based on the principle of manipulation of independent variables and examines the cause-and-effect relationship on dependent variables by controlling the effects of other variables (Frey, 2018). The second is the correlational design, which examines the extent to which differences in one variable are associated with differences in one or more other variables (Creswell & Creswell, 2017). A positive correlation indicates a positive relationship between research variables. The third represents the survey design, which refers to a process of systematically collecting data from a sample of a relatively large population and then drawing inferences (Leedy & Ormrod, 2015). This design consists of obtaining data that are valid and representative of the population of interest. The last design is the causal-comparative design in which the researcher compares two or more groups in terms of a cause (or independent variable) that has already happened (Creswell, 2014).

The study used a combination of the correlational and survey designs. A correlational research design was adopted since the literature predicted that the implementation of GSCMPs influences SCDCs, which in turn impact the performance of the manufacturing supply chain in South Africa. In this way, the study explored the causal relationships between variables of interest using SEM since this tool could yield a more conclusive cause-and-effect relationship. Additionally, the study adopted a survey design as it used questionnaires as a method of collecting data and the data collection process was carried out once, at one point in time. A survey method makes use of questionnaires as a method of gathering data and facilitates the collection of large amounts of quantitative data from the target population. It also expedites the testing and understanding of the relationships between the variables of interest. Furthermore, it enables the use of frequency distributions, percentage and mean scores to summarise the collected responses.

Apart from the reasons presented above, the impetus to use a combination of correlational and survey designs in the study derived from several previous studies in SCM where similar designs were applied. For example, a previous study by Wantao and Ramakrishnan (2016) used a correlational design to explore the roles of functional capabilities in adopting environmental management practices and improving environmental performance from an organisational capability perspective. The same study also used survey questionnaires to collect the data needed for analysis. A similar approach was adopted by Yudi *et al.* (2016) to investigate different types of innovations and their effects on eco-innovation practices by firms practising green technology in Malaysia. The study collected data using postal and online surveys. Recent research by Morteza and Atefeh (2019) tested causal relationships between research constructs such as eco-capability human relationships and technology resources. The study used survey data from staff across 15 hospitals in north of Iran.

5.6 TIME HORIZON

Research surveys are classified based on the time period in which they are extended. As a result, they can be cross-sectional or longitudinal (Sreejesh *et al*., 2014). Cross-sectional studies allow the gathering of research information at a single point in time

(Sreejesh *et al*., 2014; Leedy & Ormrod, 2015). In contrast, longitudinal studies allow the researcher to collect date repeatedly over an extended period (Blumberg *et al*., 2014). This type of research is flexible and can involve different respondents over a lengthy period provided they still form part of the original group or sub-group (Sreejesh *et al*. 2014).

The current study adopted a cross-sectional survey design since data were collected at a single point in time. This choice was motivated by the fact that cross-sectional studies enable the comparison of all variables of interest at the same time. Furthermore, a snapshot does not consider what event happens before and after the data have been collected. Through a cross-sectional strategy, information for a specific point in time from the South African manufacturers across Gauteng, Free State, Mpumalanga and Limpopo on the implementation of GSCM was collected. Additionally, this strategy helped to replace assumptions by actual facts regarding the effects of GSCM on DCs and SCP during a single time period.

Previous studies in SCM have also been conducted on a cross-sectional basis. A study by Sheng (2017) used cross-sectional data to investigate the effects of capabilities on exploratory and explorative product innovation in turbulent environments. A similar design was used by Mousavi *et al.* (2018), who gathered data from the Community Innovation Survey of German companies to test hypotheses about the effect of dynamic capabilities on innovation towards a better sustainability. Results from PLS-SEM analyses show that sensing, seizing and reconfiguring capabilities all have a significant direct effect on innovation towards sustainability, with sensing activities playing the most prominent role. Additionally, a study by Mohamed and Gharib (2019) used cross-sectional data from 193 owners and managers of SMEs in Egypt to examine the effect of absorptive capability on green innovation adoption. Gölgeci *et al.* (2019) also used cross-sectional strategy to examine the role of host-country institutional conditions in the relationships between emerging-market firms' innovation related dynamic capabilities and their international performance. They used multi-source secondary data and primary data from multiple informants from 254 Turkish international firms to test their framework.

5.7 COLLECTION OF SECONDARY DATA

Secondary data refer to using information that had already been gathered by other researchers for a different purpose (Martins *et al.*, 2018). A similar definition is also provided by Saunders, Lewis and Thornhill (2015), who describe secondary data as making use of articles, journals, or other materials from previous authors as part of a chosen research project. It is important to emphasise that secondary data provide valuable information necessary to create new knowledge through the exploration of new avenues (Cooc, 2016). In the present study, secondary data were collected through the review of literature. A literature review can be described as a comprehensive summary of previous research works found in sources which include academic journals, magazines, textbooks, among others, aimed at producing new knowledge (Galvan, 2017). Andreini and Bettinelli (2017) also define a literature review as a reliable scientific overview of extant research in a particular area of interest. Additionally, the authors perceive literature reviews as key elements in every discipline as they provide a summary of the existing evidence that is needed to inform new academic projects, policies and practices. Most importantly, literature reviews help researchers to identify major theories that apply to the area of interest and discuss whether their findings are consistent with these theories. Moreover, they help to better understand theories, hence contributing to the body of knowledge in a particular field of inquiry (Galvan & Galvan, 2017). Galvan (2017) also emphasises the importance of the literature review by stressing that its insights contribute to resolve disagreements among studies that were previously contradictory, identify new ways for interpreting results and lay paths for future research projects that have the potential to provide advancement in the field of interest.

A review of literature dealing with the concepts relevant to the study was carried out to address the theoretical research objectives deriving from the research questions. Comprehensive summaries of previous research studies on the South African manufacturing sector, GSCM, SCDCs and SCP were conducted and reported in Chapters 2, 3 and 4, respectively. Chapter 2 discussed the dynamics of the manufacturing sector across the global sphere with much and greater emphasis on the South African context. Chapter 3 discussed three theories that the researcher has identified and found important to guide the present study. It further examines GSCM and its selected practices, its drivers and challenges as well as its importance in the manufacturing sector.

Data from the preliminary literature review were obtained from sources that included books, magazines, official reports, research papers and other organisational records. Academic databases such as Emerald, Science Direct, Sabinet, EBSCOhost, Google Scholar, Sage Research Methods and other credible internet sources were also consulted. The same sources were used for the critical literature review, as well as the research methodology. It is important to note that these databases played a significant role in the current research project in providing valuable access to credible materials such as peer-reviewed articles and other important publications from experts and credible authors in the field of SCM. Moreover, they made the finding of information relevant in designing the current research project easier.

5.8 EMPIRICAL RESEARCH

Empirical research represents a form of methodological inquiry that relies on scientific evidence from observations which are needed to produce new knowledge. For the present study, it consisted of sampling design, data collection approach and data analysis as well as statistical approaches.

5.8.1 Sampling design

Since research studies are generally conducted on samples and not on populations in their entirety, this gives the sampling design a fundamental character in the research process. The procedures used to collect a sample population affect the extent to which research objectives are achieved. Sampling design describes the methods and procedures to follow for selecting a sample rather than the entire population with the purpose of drawing generalisation (Antonius, 2017; Daniel, 2017). The sampling design in the study consisted of population, target population, sample frame, sample size, sampling approach and sampling technique.

5.8.1.1 Population

A population can be described as the entire collection of elements of which the researcher wishes to draw some conclusions (Blumberg *et al*., 2014). It is important to define a population, since it allows the researcher to clearly define the characteristics elements must possess in order to be considered. The ideal scenario requires a population to possess similar characteristics to allow for adequate sampling techniques and warrant a good statistical analysis (Nardi, 2016). The population of interest in the study consisted of company's supply chain professionals within the South African manufacturing sector. They were chosen because of their knowledge of SCM as well as their involvement in supply chain activities.

5.8.1.2 Target population

A target population can be defined as a systematic description of the population of interest (Till & Matei, 2017). Defining a target population is important in delineating the survey as well as setting exclusion and inclusion conditions that can facilitate the collection of information relevant to answer the research questions (Nardi, 2016). Moreover, defining a target population was essential in the identification of respondents who were used to evaluate the implementation of GSCM and its impact on SCDCs and SCP in the South African manufacturing sector. In the study, the target population consisted of supply chain, operations and quality professionals in manufacturing firms in Gauteng, Free State, Mpumalanga and Limpopo provinces. The rationale behind this choice was that Gauteng province represents the economic powerhouse of South Africa and it is the centre of local and global businesses, including manufacturing firms. The choice of other provinces (Limpopo, Free State and Mpumalanga) was motivated by their close proximity to Gauteng as well as the fact that they also have various manufacturing companies and suppliers. Supply chain, operations and quality professionals were selected to take part in this survey because they met the inclusion criteria set out in the study which consisted of possessing knowledge of SCM and because of their roles as practitioners in supply chains. It is important to note that the findings of the current study will not be generalised across the South African manufacturing sector since there was absent of randomisation in the selection process. The results of the statistical analysis rather hold on the population sampled.

5.8.1.3 Sample frame

A sample frame refers as to the list of all elements in the target population in which the sample is drawn (Daniel, 2017; Till & Matei, 2017). It also represents a set of potential respondents from which the researcher selects a subset of the target population (Nardi, 2016). The beauty of a good and adequate sampling frame is that it provides a specific list of the target population and contains accurate information that can be used to contact potential respondents. Blumberg *et al*. (2014) argue that in an ideal scenario, a sample frame must be complete, correct and accurate. This implies that obsolete sample frames are not required since they will not provide complete and accurate information needed to conduct survey research.

In some cases, it can be very difficult and too costly to find an adequate sampling frame. These challenges very often result in finding alternative research design that do not require a population list (Allen, 2018). This was the case for the current study since there was no single list of the supply chain, operations and quality professionals for manufacturing companies in the four provinces where data were collected. Moreover, in the current economic turmoil and health crisis where manufacturing companies were shutting down their operations because of the Covid-19 pandemic, directories were likely to contain errors and omissions, or may have simply been inaccessible. According to Daniel (2017), a good sample frame must be free of bias, accurate, reliable and contain updated information (Daniel, 2017). Since meeting these requirements involves considerable amount of time and resources, the present study did not require a predefined sample frame as manufacturing firms were selected conveniently and respondents were chosen purposefully from these manufacturing firms across four South African provinces, namely Gauteng, Free State, Mpumalanga and Limpopo.

5.8.1.4 Sample size

Sample size is the number of elements that form a subset of the population of interest (Sreejesh *et al*., 2014). The present study firstly used historical evidence which consisted of observing and presenting sample sizes used in previous research on GSCM to determine the size of the sample that was needed. The minimum recommended sample sizes from seminal scholars were also applied. Table 5.1 portrays few historical pieces of evidence of studies conducted on GSCM, the sample size used, as well as models adopted for data analysis.

Table 5.1: Sample size and analytical models of previous studies conducted.

Construct	Previous studies (Authors)	Country	Sample size used	Sample selection strategy	Analytical model
Green Purchase	Çankaya & Sezen (2019:100)	Turkey	281	Probability Sampling	SEM

Construct	Previous studies (Authors)	Country	Sample size used	Sample selection strategy	Analytical model
				(random sampling)	
	Ghosh (2019)	India	80	Probability Sampling (random sampling)	CFA
Eco-design	Kirchoff *et al.* (2016:272)	US	367	Nonprobability Sampling (convenience sampling)	SEM
	Fernando *et al.* (2016: 221)	Malaysia	95	Probability sampling (random sampling)	One-way Analysis of Variance (one-way ANOVA)
	Liu *et al.* (2018)	China	216	Probability Sampling (random sampling)	SEM
Green Manufacturing	Choi *et al.* (2018: 1029)	South Korea	322	Probability Sampling (random sampling)	SEM
Green distribution	Hong *et al.* (2018:3509)	China	209	Probability Sampling (random sampling)	SEM
Reverse Logistics	Morgan *et al.* (2016: 297)	US	267	Probability Sampling (random sampling)	SEM
	Mahindroo *et al.* (2018: 550)	India	306	Nonprobability Sampling (convenience and snowball sampling)	Moderated Regression Analysis
Legislation and regulations	Huang *et al.* (2015:85)	China	202	Probability Sampling (random Sampling)	Descriptive and Analysis of Variance (ANOVA)
	Choudhary & Sangwan (2018:3631)	India	233	Probability Sampling (random sampling)	EFA and Cluster Analysis
Green training	Teixeira *et al.* (2016)	Brazil	95	Probability Sampling (random sampling)	SEM
Supply Chain Dynamic Capabilities	Dias & Pereira (2017:420)	Portugal	207	Probability Sampling (random sampling	EFA and Reliability Analysis
	Lee & Rha (2016:3)	South Korea	316	Probability Sampling (random sampling)	SEM

Construct	Previous studies (Authors)	Country	Sample size used	Sample selection strategy	Analytical model
Supply chain performance	Odongo *et al.* (2016:1785)	Uganda	150	Nonprobability Sampling (judgemental and snowball sampling)	SEM
	Sundram *et al.* (2016:1447)	Malaysia	156	Probability Sampling (random sampling	Sobel test, Bootstrapping approach and CFA
SEM= Structural Equation Modelling CFA= Confirmatory Factor Analysis EFA= Exploratory Factor Analysis					

Source: Author's own compilation.

Table 5.1 indicates that the minimum sample size is 80 respondents, and the maximum size is 367 respondents, giving an average of 235 respondents. Frey (2018) ascertains that when using a non-probability sampling design, a sample size between 450 and 550 may satisfy the requirement of the hypothesis tester, power analysis (ability to use a sample to detect a relationship in a population) and parameter fitter. As a rule of thumb, one effective way to improve the statistical power is to increase the sample size (Vogt *et al.*, 2012). As sample size increases, the standard errors of the mean decrease. Nardi (2016) further suggests that a representative sample size of 200 respondents is enough to warrant the statistical power.

Since the relationships between the variables of interest were determined using SEM and given the fact that SEM is a very large sample technique, Kevin (2017) recommends a minimum sample size of 200 observations. Similarly, as a rule of thumb, Allen (2018) also suggests a sample size of 200 for a close fit test (i.e. RMSEA). As a rough rule of thumb, Blunch (2017) ascertains that the sample size should be at least 10 times the number of parameters to be estimated, the minimum being a subject parameter-ratio of 10:1. The same author further suggests that a sample size should be between 200-300 observations as a minimum. Since the current study used exploratory factor analysis, Allen (2018) suggests the sample size should decrease as communalities increase, variables per factor increase and the total number of factors decrease. Moreover, the same author stresses that as communalities drop to 0.3 a study can require as much as 400 respondents. Based on this pool of information the final sample size for the present study was n=402 respondents.

5.8.1.5 Sampling approach

A sample approach describes a framework that helps select the appropriate sample. The sampling design comprises two types of samples, which include probability and non-probability samples. Probability sampling entails selecting a sample randomly in a way that gives equal chance to each element of the target population of being selected (Antonius, 2017; Daniel, 2017). In contrast, non-probability sampling represents a method of selection in which elements of the population have little or no chance of being chosen. In order words, the researcher has no means of predicting or guaranteeing that each element of the population will be sampled (Leedy & Ormrod, 2015; Vehovar *et al.*, 2017).

The present study adopted a non-probability sampling since the selection of respondents was left at the discretion of the researcher. The first and most important rationale behind this choice was the lack of a single sampling frame, which is the list of all supply chain professionals within the South African manufacturing sector in the four provinces considered in the study. Any attempt to produce a single list in such case would have resulted in bias since it often includes omissions and errors (Vogt *et al*., 2012). One way to improve survey research was to approach the office of the South African Manufacturing Association to obtain a list of manufacturing companies or for the study to develop a sample frame. This is not an easy task as it requires much time and money. However, this exercise would not have provided the list of supply chain professionals. Moreover, recruiting respondents that were spread out across four South African provinces was difficult since many companies were not willing to share their information with outsiders. Others did not want to cooperate by simply declining calls or ignoring emails requesting them to take part to the survey. These challenges made the application of non-probability sampling the only feasible sampling method in the current study.

Furthermore, a non-probability sampling approach requires fewer resources as it is quick and cheaper to conduct than probabilistic sampling. Daniel (2017) and Till and Matei (2017) argue that probability sampling can be full of hurdles and it is costly in its implementation especially in a dispersed environment. This was the case with the present study where manufacturing companies were spread across four provinces in South Africa. In support of the application of non-probability sampling in complex situations such as the current study, Frey (2018) argues that if tests of reliability and validity are conducted with samples that are diverse during the data analysis process, a representative probability sampling is not necessary and can be substituted with a nonprobability sampling, which is relatively quick and cheaper. A pilot test was required where survey questionnaires were delivered to SCM professionals located across the four provinces under consideration in the current study to increase diversity and variability. Scherbaum and Shockley (2019) argue that non-probability sampling methods are commonly used in both academic and applied research. Moreover, many of new technology-enabled methods of sampling (i.e. crowd sourcing) that have been popularised are non-probability methods (Scherbaum & Shockley, 2019). Table 5.2 provides evidence of sample approaches and techniques of previous studies conducted on SCM in South Africa.

Table 5.2: List of few previous studies in supply chain management and the sampling approaches used in South Africa

Authors	Sample size	Research approach	Sampling strategy	Justification	Region
Mafini & Muposhi (2017).	312	Quantitative	Non-probabilistic convenient sampling	No reliable sampling frame exists	Gauteng
Matsoma & Ambe (2017)	56	Quantitative	Non-probabilistic convenient sampling	No reliable sampling frame exists	Gauteng
Nguegan & Mafini (2017)	303	Quantitative	Non-probabilistic purposive sampling	Non availability of the sample frame	Gauteng
Bag *et al.* (2018)	150	Quantitative	Non-probabilistic convenient sampling	Not provided	All regions
Bag *et al.* (2018)	175	Quantitative	Non-probabilistic convenient sampling	Not provided	Kwazulu-Natal
Mashiloane *et al.* (2018)	340	Quantitative	Non-probabilistic	Not provided	Gauteng

Authors	Sample size	Research approach	Sampling strategy	Justification	Region
			purposive sampling		
Zondo (2018).	44	Quantitative	Non-probabilistic convenient sampling	Not provided	Kwazulu-Natal

Source: Author's own compilation.

An analysis of Table 5.2 invokes thoughts of probable complexities some researchers may have encountered in collecting data from respondents using probability sampling techniques. These complexities may have included the unavailability of sample frames or the difficulty of compiling sample frames and most importantly the cost associated with the implementation of probability sampling in terms of time and money. These hurdles may have led to the shift of a more realistic and readily available model such as non-probabilistic sampling design. Frey (2018) argues that since the 21st century, surveys based on probability sampling have been experiencing a decline in response rates due to complexities in gathering data, hence compromising the integrity of the statistical analysis. Given the fact that the current study had limited time and resources, the risk of compromising the project as a result of low-level of response rate that usually occurs when using probability sampling was averted by using the alternative design. Thus, the current study adopted a non-probability sampling design.

5.8.1.6 Sampling techniques

A sampling technique represents a process of selecting elements in the target populations (Vogt *et al*., 2012). Probability sampling techniques include, random, systematic, cluster and stratified random samplings (Antonius, 2017). Conversely, non-probability sampling comprises quota, convenience and purposive samplings (Leedy & Ormrod, 2015; Antonius, 2017). Blumberg *et al*. (2014) suggest that a purposive sampling technique includes judgemental and quota samplings. Judgement occurs when a researcher uses some form of criterion to select elements from the population while quota sampling is based on a logic that certain relevant characteristics describe the dimensions of the population of interest (Blumberg *et al*., 2014).

The selection of companies within the South African manufacturing that participated in the study was achieved using convenience sampling. Convenient sampling refers to a process of selecting readily and easily available subjects to take part to a survey (Farrokhi & Mahmoudi-Hamidabad, 2012; Taherdoost, 2016). This sampling technique tends to accommodate research projects with limited resources in terms of time and money as it was the case for the current study. Additionally, Etikan *et al.* (2015) postulate that convenient sampling uses non-random technique to select subjects based on criteria which include easy accessibility, geographical proximity, willingness to participate in the study and availability of time. Manufacturing companies were identified using online directories, complemented by yellow pages, which is a telephone directory of companies. It is important to note that only those manufacturing companies that showed willingness to take part to the survey were selected. A convenient sampling technique for selecting manufacturing companies was quick, cheap and selected only those enterprises that were readily available within the South African manufacturing sector.

To select actual respondents (supply chain, operations and quality professionals), the present study adopted the Blumberg *et al*.'s (2014) approach to sampling, which classifies purposive sampling as judgemental and quota samplings. The sampled elements were intentionally selected based on their possession of some characteristics relevant to the research questions. In the case of the current study, the prerequisite consisted of possessing knowledge of SCM and being involved in SC activities. The quota sample (number of respondents) per province was proportional to the relative contribution of each province to the total manufacturing. The South African Market Insights (2020) reports that in 2016, Gauteng province contributed towards 40.30 per cent to the total manufacturing in South Africa while Mpumalanga, Free State and Limpopo contributed 7.10 per cent, 4.0 per cent and 1.5 per cent, respectively. These respective contributions were used as a basis to determine the sample size of each province.

Furthermore, Scherbaum and Shockley (2019) posit that purposive sampling method has the potential, especially in populations of limited size, to produce highly representative samples. Blumberg *et al*. (2014) and Antonius (2017) argue that quota sampling shares some characteristics with probabilistic stratified random sampling since they both include groups in sample proportions. This gives the quota sampling technique a unique sampling characteristic that can help eliminate distortions and improve the representativeness as well as the sample bias, especially where validity has been checked (Vogt *et al*., 2012; Vehovar *et al*., 2017). Daniel (2017) also suggests that purposive sampling is based on central tendency (the sampled elements are considered to be average of the unit of analysis), variability (the elements are selected as a result of their common characteristics), theoretical model (elements are sampled because they confirm a theory or hypothesis) and judgment (elements are selected for their ability to provide useful information). Purposive sampling may represent an efficient way of collecting data from the desired types of target population than probabilistic sampling, especially in a context of limited resources and small size of the target population (Frey, 2018).

Based on these arguments, the present study argues that respondents across the South African manufacturing sector shared common characteristics, which was the knowledge of SCM as well as their involvement in SC activities. This gives respondents a homogeneous character that is characterised as presentative of the population of interest. The present study used data in Table 5.3 from the South African Market insights (2020) to determine the sample size. Table 5.3 provides the relative contributions of manufacturing firms per province to the total manufacturing in 2016 and was used to determine the quota samples.

Table 5.3: Planning of quota samples based on the relative contributions of manufacturing firms per province to the manufacturing sector.

Province	**Relative contribution percentage per province**	**Ratio per province in simplified form** $(\frac{Individual\ contribution}{Total\ contributions})$	**Total sample size**	**Number of respondents per sample group** $(Sample\ size * ratio)$
Gauteng	40.30%	.761	500	381
Mpumalanga	7.10%	.134		67
Free State	4.00%	.075		38
Limpopo	1.50%	.028		14
Total contribution	**52.9%**			**500**

Source: South African Market Insights (2020).

In Table 5.3, it can be seen that Gauteng province contributes the most to the total manufacturing and Limpopo contributes the least. The combined contributions to the manufacturing of the four provinces amounts to around 53%. The present study selected respondents from companies in the same proportion as their relative contribution to the total manufacturing.

5.9 Data collection instrument

Data collection is considered as a vital component in research projects. If data are not collected in a well-established, rigorous and systematic manner, they will not provide the basis for scientific knowledge which is expected to derive from the process. Consequently, data collection can be defined as a process of acquiring facts from the studied environment to find answers to research problems (Blumberg *et al*., 2014). The primary mode of data collection in the current study was a self-administered survey questionnaire. A self-administer survey questionnaire requires respondents to complete questionnaires on their own and handing them back to the researcher through their method of convenience which include emails, post, hand delivery, fax, or through web-based surveys (Paterson, 2016).

The survey questionnaire is cheap and allows respondents to answer to questions at their convenience and anonymity. Moreover, given the fact that respondents are often difficult to reach out due to time constraints and other operational commitments, this makes a survey questionnaire the appropriate method of data collection. In addition, respondents are not subjected to the researcher influence. It is important to emphasise that a survey questionnaire plays a vital role in the data collection process since it requires that the researcher shows some level of inquiry skills in asking relevant questions that probe and prompt respondents to provide useful information.

Survey questionnaires can be classified as structured and unstructured. A structured questionnaire is a questionnaire that has a specified number of questions and gives respondents the possibility to choose among alternatives provided. In contrast, an unstructured questionnaire is usually open-ended and tries to probe into the mind of respondents, allowing them to express their own opinions and thoughts rather than restricting them to available response options (Sreejesh *et al*., 2014). The study used structured questionnaires since questions were standardised as well as the vocabulary. Moreover, a structured questionnaire is quick to complete and saves respondents considerable amount of their precious time. This type of questionnaire also prevents deviations from the actual topic by guiding research participants. It also reduces the possibility of bias as respondents often express their own opinions and interpretations in unstructured questionnaires.

5.9.1 Cover page of the questionnaire

The cover page plays its own role by providing respondents with an overview of information regarding the questionnaire. It also provides details of what is required from respondents in their endeavour to take part in the study. Developing a well-designed cover page is likely to increase response rate by influencing respondent decisions to cooperate with the requested task. For the current study, the cover page of the questionnaire included information related to the title of the project, the confidentiality requirement, the researcher's and supervisor's names and contact details, the time required to complete the survey and the option to indicate whether respondents will require a copy of the results. For those respondents that required a copy of the results, they were requested to provide their email addresses.

5.9.2 Structure of the questionnaire

The questionnaire comprised five sections, each pertaining to a specific area of inquiry: Section A elicited information about the profile of South African manufacturing companies participating in the study. Section B elicited information related to the demography of respondents, while section C requested information regarding GSCM practices. The questions of section C were adapted from Laosirihongthong *et al.* (2013), Kirchoff *et al.* (2016), Morgan Richey Jr and Autry (2016), Younis *et al.* (2016), Nejati Rabiei and Jabbour (2017), Choudhary and Sangwan (2018), Jasmi and Fernando (2018), Çankaya and Sezen (2019) and Liu *et al.* (2020). Section D attempted to find responses on SCDCs, and questions were adapted from Hong *et al*. (2018). Section E questions were adapted from Sindhuja (2014), Huo *et al.* (2016), Song and Liao (2018), Sundram *et al.* (2016), Delic *et al,* (2019), Yu *et al.* (2019) and Peng *et al.* (2020) and were used to measure the performance of the supply chain. Respondents were asked to rate statements using a five-point Likert scale anchored by 1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree. It is important to note that the use of neutral response in the five-point Likert scale may have created a risk of response bias introduced by respondents through the tendency of choosing the mid-point as a matter of ease. Moreover, according to Pornel and Saldaña, (2013) and Chyung, Roberts, Swanson and Hankinson, (2017) a neutral response in the five-point Likert scale compared with the four-point Likert (which does not have a mid-point) scale may signify a true neutral (such as neither/nor, neutral, and indifferent) or nonresponse (such as undecided, don't know, never thought of it, and no opinion). This type of scenario may lead to epistemological issue. However, during the analysis, the mean scores of data (quota samples) obtained from respondents of provinces of interest were compared to determine the level of bias. The study ensured that questions were easy to understand and did not produce emotions by remaining strictly professional. The research questionnaire is provided in Appendix 1 of this document.

5.9.3 Construct items

Constructs under considerafive-pointe current research project were developed from previous research studies. Their roles consisted of evaluating the implementation of GSCM, assessing the effectiveness of DCs and measuring the SCP of manufacturing firms in the South African manufacturing sector. A total of 78 measurement items were included in the questionnaire and were organised as follows: GSCMPs consisted of 40 measurement items presented in Table 5.4, SCDCs consisted of 5 measurement items and SCP comprised 33 measurement items all presented in Table 5.5. They helped to capture the implementation of GSCM and its implication on SCDCs and SCP in the South African manufacturing sector.

5.9.4 Measurement items

This section presents measurement items that were adapted for the purpose of the current study and included section C to E.

5.9.4.1 Section C

Section C of the survey questionnaire sought information regarding the implementation of GSCM practices. Evaluation items were adapted from the sources presented in Table 5.4.

Table 5.4: Constructs and measurement items

Construct	Item code	Measurement item	α	Source
Green Purchasing	GP1	Our company provides design specifications to suppliers that include environmental requirements for purchased items.	0.83	Younis *et al.* (2016)
	GP2	Our company performs environmental audits for suppliers' internal management.		
	GP3	Our company evaluates whether second-tier suppliers are using environmentally friendly practices.		
	GP4	Our suppliers are selected based on environmental criteria.		
	GP5	Our company requires suppliers to use environmentally friendly packaging (degradable and non-hazardous).		
	GP6	Our company requires suppliers to be certified ISO14000.	0.79	Çankaya & Sezen (2019)
Eco-design	ED1	Our company designs products in a way that reduces the consumption of materials/energy.	0.82	Younis *et al*. (2016)
	ED2	Our company designs products for reuse, recycle, recovery of materials and component parts.		
	ED3	Our company designs processes that minimise waste.		
	ED4	Our company designs products in a way to avoid or reduce the use of hazardous products.		
	ED5	Our company designs or redesigns products to reduce their overall environmental impact.	0.82	Kirchoff *et al.* (2016)
	ED6	Our company reuses scraps and waste as inputs to saleable products.		
Green Manufacturing	GM1	Our company implements total quality environmental management.	0.85	Liu *et al.* (2020)
	GM2	Our company substitutes polluting and hazardous materials with environmentally friendly ones.	0.76	Çankaya & Sezen (2019)
	GM3	Our company filters and controls its emissions and effluents.		
	GM4	Our production planning and control focus on reducing waste and optimising the exploitation materials.		
	GM5	Our process design focusses on reducing energy and the consumption of natural resources in our operations.		
Green Distribution	GD1	Our company has optimised operational processes to reduce waste	0.92	Jasmi & Fernando (2018)

Construct	Item code	Measurement item	α	Source
		in a way that controls logistics operations.		
	GD2	Our company has improved the on-time delivery rates in recent years.	0.83	Abdallah & Al-Ghwayeen (2019)
	GD3	Our company coordinates resources with its suppliers to achieve environmental goals.	0.96	Liu *et al.* (2020)
	GD4	Our company optimises effective routing systems to minimise travel distances.	0.76	Çankaya & Sezen (2019)
	GD5	Our company consolidates effective shipments and full vehicle loadings.	0.76	
	GD6	Our company selects cleaner transportation methods.	0.76	
Reverse Logistics	RL1	Our company is effective in handling product/service recalls.	0.94	Morgan Richey Jr & Autry (2016)
	RL2	Our company guarantees the quality of re-work and repairs.		
	RL3	Our company ensures completeness of re-work and repairs.		
	RL4	Our company ensures timeliness of re-work and repairs.	0.71	Younis *et al*. (2016)
	RL5	Our company accepts packaging that has been returned by customers.		
	RL6	Our company makes joint decisions with our supply base about ways to reduce overall environmental impact of logistics operations.	0.89	Kirchoff *et al.* (2016)
Legislation and Regulations	LR1	Our company adopts green supply chain initiatives to avoid the threat of legislation.	0.85	Laosirihongthong, Adebanjo & Tan (2013)
	LR2	Our company perceives environmental standards as difficult to comply with.		
	LR3	Our company is subjected to frequent government inspections.		
	LR4	Our company perceives that there are too many government environmental regulations.		
	LR5	Our company promotes customer awareness about environmentally friendly products.	0.74	Choudhary & Sangwan (2018)
	LR6	Our company receives incentives from the Government (financial and non-financial).		
Green Training	GT1	Our company provides green education and training to employees.	0.89	Liu et al. (2020)
	GT2	Generally, our employees are satisfied with the green training offered.	0.89	Nejati Rabiei & Jabbour (2017)
	GT3	The topics considered during green training are appropriate and current for company activities.		

Construct	Item code	Measurement item	α	Source
	GT4	Formal environmental training programs are offered to employees in order to increase their promotional ability in the company.		
	GT5	Employees who receive green training have the opportunity to apply green knowledge in everyday activities.		
Note*: α represents the Cronbach's alpha consistency and shall be ≥ 0.70*				

Sources: Adapted from: Laosirihongthong *et al.* (2013); Kirchoff *et al.* (2016); Morgan Richey Jr and Autry (2016); Younis *et al.* (2016); Nejati Rabiei and Jabbour (2017); Choudhary and Sangwan (2018); Jasmi and Fernando (2018); Çankaya and Sezen (2019); Liu *et al.* (2020).

Table 5.4 shows the seven dimensions of GSCM under consideration in the current study and include GP; ED; GM; GD; RL; LR; and GT. These dimensions helped to analyse, evaluate and control the performance of the implementation of green practices. Cronbach's alpha coefficients for all factors were greater than 0.60 and varied between 0.71 and 0.96, indicating high level of reliability of each factor. Therefore, the study argues that the scale measuring GSCM was reliable and appropriate for the current study.

5.9.4.2 Sections D and E

Section D attempted to find responses on the effectiveness of SCDCs while Section E sought to measure the performance of the supply chain. Constructs were described according to the works of sources presented in Table 5.5.

Table 5.5: Constructs and measurement items

Constructs	Item code	Measurement item	α	Sources
Supply chain Dynamic Capabilities	SCDC1	Our company has been able to stimulate knowledge acquisition and absorptive capacity.	0.88	Hong *et al.* (2018)
	SCDC2	Our company has a market-oriented perception ability.		
	SCDC3	Our company has developed innovation abilities.		
	SCDC4	Our company has an internal reconstruction ability.		
	SCDC5	Our company has built a social network relationship ability.		

Constructs	Item code	Measurement item	α	Sources
Supply Chain Agility	SCA1	Our supply chain is able to respond to changes in market demands without overstocks or lost sales.	0.88	Sindhuja (2014)
	SCA2	Our supply chain is able to leverage the competencies of our partners to respond to market demands.		
	SCA3	Our supply chain is able to forecast market demands.		
	SCA4	Our supply chain has reduced in-bound lead-times.		
	SCA5	Our supply chain ensures non-value-added time reductions in the pipeline.		
Supply Chain Reliability	SCREL1	Our supply chain system increases our order fill rate.	0.88	Sindhuja (2014)
	SCREL2	Our supply chain system increases our inventory turnover.		
	SCREL3	Our supply chain system reduces our safety stocks.		
	SCREL4	Our supply chain system reduces our product warranty claims	0.76	Delic *et al.* (2019)
	SCREL5	Our supply chain system reduces our inventory obsolescence.	0.88	Sindhuja (2014)
Supply Chain Cost	SCC1	Our supply chain system reduces inbound and outbound costs.	0.88	Sindhuja (2014)
	SCC2	Our supply chain system reduces warehousing costs.		
	SCC3	Our supply chain system reduces inventory-holding costs.		
	SCC4	Reduced energy consumption costs.	0.85	Peng *et al.* (2020)
	SCC5	Our supply chain system reduces our product warranty claims.	0.88	Sindhuja (2014)
Supply Chain Responsiveness	SCR1	Our supply chain has short order fulfilment lead times.	0.88	Sindhuja (2014)
	SCR2	Our supply chain has short order-to-delivery cycle times.		
	SCR3	Our supply chain has fast customer response times.		
	SCR4	If a major competitor were to launch an intensive campaign targeted at our customers, our company would implement a response immediately.	0.85	Song & Liao (2018)
	SCR5	Our company is quick to respond to significant changes in our competitors' pricing structures.		
	SCR6	The relationships with our partners have increased our supply chain	0.94	Yu *et al.* (2019)

Constructs	Item code	Measurement item	α	Sources
		responsiveness to market changes through collaboration.		
Supply Chain Quality	SCQ1	Our final products conform to design specifications.	0.85	Huo *et al.* (2016)
	SCQ2	Our company ensures that its final products perform optimally.		
	SCQ3	Our company ensures on-time deliveries.		
	SCQ4	Our company provides accurate deliveries.		
	SCQ5	Our company is flexible in delivery times.		
	SCQ6	Our company always ensures speedy deliveries of its products.		
Supply Chain Balance	SCB1	Our company shares risks and rewards with its supply chain members.	0.76	Sundram *et al.* (2016)
	SCB2	Our company shares research and development costs and results with its supply chain members.	0.76	
	SCB3	Our company has continual joint improvement programs with its key supply chain partners.	0.85	Huo *et al*. (2016)
	SCB4	Our relationships with key supply chain partners contribute to improve our manufacturing performance.	0.85	
	SCB5	There is an optimum exchange of information between our company and its supply chain members.	0.88	
	SCB6	Our company and its supply chain partners keep each other informed about events or changes that may affect the other party.	0.88	
Note: *α represents the Cronbach's alpha consistency and shall be ≥ 0.70*				

Sources: Sindhuja (2014); Huo *et al.* (2016); Song and Liao (2018); Sundram *et al.* (2016); Hong *et al.* (2018); Delic *et al.* (2019); Yu *et al.* (2019); Peng *et al.* (2020).

Table 5.5 presents the combined dimensions of adaptative capability, which entails taking advantage of opportunities that arise in the supply chains; absorptive capacity, which represents the ability of a firm to collaborate, integrate, coordinate and exploit information from business intelligence for commercial purposes; and innovative capability, which refers to the ability to generate new competencies resulting in product development and processes (i.e. green production) into a single research construct configured as SCDCs, suitable to compete and achieve sustainable competitive advantage in a dynamic environment. Table 5.5 also presents the performance indicators that were used to evaluate the performance of the South African manufacturing sector in terms agility, reliability, costs, responsiveness, quality and balance. Additionally, Table 5.5 reveals that Cronbach's alpha coefficients for all factors were greater than 0.60 and range from 0.76 and 0.94, indicating high level of reliability of each factor. Therefore, the study argued that the scales measuring SCDCs, and SCP were reliable and appropriate for the current project.

5.9.5 Adaptation of the questionnaire survey.

A questionnaire adjustment can be described as a process of adapting questionnaire to better fit the characteristics of the new population of interest (Clinciu & Cazan, 2014). Arsalani *et al.* (2011) postulate that when researchers decide to adapt questionnaires, they must select relevant questions to develop a shortened instrument while maintaining good measurement properties. Adaptation may be made in a form of adjusting content, format, response scale or visual representations of a question or questionnaire with a purpose of meeting new needs (Clinciu & Cazan, 2014). Changes to original questionnaires can be made to fit the new population needs in terms of vocabulary, presentation, or translation to another language (Arsalani *et al*., 2011). No translation was required to the original versions of the adapted questionnaire since they were in English and English represents one of the official languages in South Africa. Very few changes were made to items on vocabulary and presentation since the borrowed questionnaires possessed common characteristics with the present study.

The questionnaire developed in the present study was adapted from sources presented in Tables 5.4 and 5.5. The adapted instruments consisted of three areas of interest which included, firstly the practices of GSCM (GP, ED, GM, GD, RL, LR & GT). Questions on GSCM consisted of items that capture the concept and the implementation of sustainable supply chain practices. The second area of interest consisted of SCDCs in which questions included items that addressed the rigidity of routine activities through sensing and seizing of supply chain opportunities, the ability of a firm to collaborate, integrate, coordinate and exploit information and the ability to innovate and adapt to market conditions. The third area of interest consisted of items that evaluated the performance of the SCN in terms of agility, reliability, costs, responsiveness, quality and balance. These areas of interest helped the present study to confirm or refute that the implementation of GSCM translates to higher SCP through the mediating role of SCDCs. Moreover, during the test of validity, ambiguities and lack of clarity were not detected and therefore, the questionnaire was not adjusted. Since most of the studies in Table 5.4 and 5.5 successfully used the five-point Likert scales for reasons of compatibility with these instruments, the current study used a five-point Likert scale ranging from 1 – Strongly disagree to 5 – Strongly agree in the survey instrument to quantify the existence of each measure.

A study by Arsalani *et al*. (2011) in which they developed a questionnaire in the Persian language in order to assess personal factors, working conditions and health problems among nursing personnel recommended that such questionnaire should be tested for reliability and validity. Beyers and Goossens (2002) also tested questionnaires for validity and reliability in an attempt to examine the validity of scores on the Student Adaptation to College Questionnaire in a sample of European university students. Since the adapted questionnaires were tested for internal consistency through Cronbach's alpha coefficients, the present study selected only those item measurements that met the requirements of internal consistency. It is important to recognise that all adapted measurement items were found to have $\alpha \geq 0.60$, which was sufficient to consider their usage in the development of the questionnaire of the current study. Moreover, since validity tests form part of the current research design, the questionnaire was tested for validity through content and face validities.

5.9.6 Response methods

Questioning is the most used stimulus for measuring concepts and constructs. A variety of response scales (i.e. simple category scale, multichoice single-response scale, numerical scale, fixed sum scale, among others) are available for judging properties through evaluations (Blumberg *et al*., 2014). The current study used a Likert scale that provided response options from Section C to Section E of the survey questionnaire attached in Appendix 1. The Likert scaling is a commonly used response scale format in psychometry for measuring self-reported attitudes, perceptions, or beliefs about something (Joshi *et al.* 2015). The Likert scale also describes a measure of a person's attitudes, beliefs, or opinions about some object or event (Allen, 2018:12). Surveys employing Likert-type scales consist of items (i.e. most frequently declarative statements) to which respondents select a numeric response (Allen, 2018; Frey, 2018). The study's Likert scale consisted of a set of declarative statements, each followed by a series of ordered response options that measured the extent to which respondents agree or disagree with the statements. This allowed to capture information drawn from respondents from manufacturing firms across the four South African provinces under consideration in the current study.

The questionnaire survey involved the use of five-point Likert scale questions, which are important measures for defining the interactions between practices and performance measures. The five-point Likert scale appears to be less confusing and frustrating for respondents than the seven-point scale, thus likely to increase response rate. Moreover, the five-point design scale is easily comprehensive and provides a mid-point (neutral) for respondents who are uncertain about their responses. Additionally, a mid-point allows respondents to accurately express their true attitude or belief about a particular statement (Allen, 2018). Although there are fewer options available on the five-point Likert scale than on the seven-point scale, and given the reliability of responses, it is possible that the seven-point scale will perform better than the five-point scale (Joshi et al., 2015). The variety of options in the seven-point scale increases the probability of meeting the objective reality of respondents and practically appeals to their faculties to reason. The choice of five-point Likert scale stemmed from its ability to improve response rate and avoid confusions and loss of interest in responding to questions. Respondents were asked to provide their level of agreement with the given statements on a metric scale. They rated statements using a five-point Likert scale anchored by 1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 –Agree; 5 – Strongly agree. Since measures from this instrument typically addressed attitudes or perceptions which are not tangible in nature, it was crucial that the study examined both the reliability and validity of inferences drawn from the scores. They are intensively discussed in section 5.13 of this document.

5.10 DATA COLLECTION PROCEDURES

Data collection can be defined as a process of acquiring factual information from a studied environment with the aim of responding to research questions (Blumberg *et al.*, 2014). In the current study, the primary mode of data collection was a self-administered survey questionnaire technique. The questionnaires were sent to SCM professionals, quality professionals and operations professionals of manufacturing firms across four South African provinces which include Gauteng, Free State, Mpumalanga and Limpopo. This method of data collection is relatively cheap, quick and is an efficient way of obtaining data from respondents. Since the questionnaires were self-administered, they were sent to respondents via two dedicated channels which included emails or online surveys. The online survey questionnaire was designed through Microsoft forms and included the same questions as the main questionnaire. Microsoft forms generated a link and the obtained link was then sent to respondents who could access the questionnaire through mobile devices. Prior to sending the questionnaires, respondents were called to determine their preferred mode of delivery. For those who preferred emails, they were given the options to select between receiving the questionnaire in a word format document or in a form of link to allow them to access the questionnaire. This mode of responding to questionnaires was quick and increased the response rate especially for those respondents outside Gauteng province.

Respondents, regardless of their mode of delivery of questionnaires were given a two-week window period to complete questionnaires and return them. For questionnaires that were not received within the specified timeframe, a follow-up approach was initiated until most questionnaires were received.

5.11 Procedures for dealing with data related problems.

When conducting a research study, strategies used to collect or analyse data come with some degree of bias. A bias can be defined as any form of influence that distorts the data obtained or the research findings (Bruce & Bruce, 2017). It is important to note that bias in research studies comes in many forms, which include but not limited to response bias, non-response bias, sampling bias and common method variance. These distortions pose a threat to the validity and integrity of the findings, making it important to find appropriate means to mitigate their effects before and after the data collection.

5.11.1 Response bias

Response bias describes the extent to which respondents provide inaccurate answers to survey questionnaires based on their personal experiences, beliefs and thoughts (Leedy & Ormrod, 2015). This type of bias occurs when respondents intentionally or unintentionally misrepresent facts to provide a favourable impression. Additionally, respondents may also choose the most extreme or neutral options when responding to survey questionnaires. In the current study, respondents were asked to take their time when completing the survey to provide truthful and accurate responses. During the analysis, the mean scores of data (quota samples) obtained from respondents of the provinces of interest were compared to determine the level of bias. The study ensured that questions were easy to understand and did not produce emotions by remaining strictly professional. Moreover, since the questionnaire used a 5-point Likert scale, it did not compromise the integrity of responses. The questionnaire consisted of five sections each targeting a different area of interest to make respondents think about each question instead of just providing answers routinely.

5.11.2 Non-response bias

Nonresponse bias occurs when there is a significant difference between those who responded to the survey questionnaires and those who did not, resulting in a sample losing its representativeness (Vogt *et al*., 2012). In other words, a non-response bias occurs when respondents do not complete the survey for whatever reasons. A non-response bias can be considered as a result of low level of responses as well as a difference between respondents and non-respondents.

To reduce non-response bias, the study adopted Geyi *et al*.'s (2019) approach in which early received responses are compared with the late received ones, also considered as a proxy for non-respondents. Early responses were considered as those received before initiating the reminder process through calls or emails while late responses consisted of those received after the reminder was triggered. It is important to mention that when respondents were called to remind them of their commitment to complete the survey questionnaires, the researcher borne in mind that they could withdraw from the study whenever they wanted. The independent samples t-test was conducted to compare the mean scores between early and late responses. There was no significant difference between the means of the two groups to indicate a non-response bias. Moreover, missing respondents were substituted by other respondents fulfilling the same selection criteria to improve the non-response bias.

5.11.3 Sampling bias

Sampling bias refers to a factor that yields a non-representative sample of the population being studied (Leedy & Ormrod, 2015). Frey (2018) postulates that respondents who are assigned based on cost, convenience, or other conditions as opposed to probability selection process may introduce some forms of sampling bias. Since the current study used a non-probability sampling design, the researcher recognised that the sampling bias was automatically included as a result of the absence of non-random criteria. Given the fact that random sampling is not always possible due to its complexities and given that the selection was socially desirable to the researcher, the current study used a quota sampling technique to improve the sample representativeness and the sample distortion. Additionally, since respondents were selected based on their knowledge of SCM, the strategy depicted a homogeneous character which could be categorised as sample that was representative of the population.

Furthermore, as the quota sampling technique has similar requirements for sampling size as probabilistic sampling techniques, a bigger sample size (i.e. 500 respondents) as planned by the current study was used as a mean to reduce the sample bias. Frey (2018) argues that when sample size is sufficiently large, it is more likely to produce group equivalence before the independent variable is applied. In line with this assertion, respondents in the current study were assigned in groups (quota sampling) as per the relative contribution of manufacturing firms to the total manufacturing in South Africa.

5.11.4 Common method variance

Common method variance (CVM) can be characterised as a situation where the instrument used to collect data causes a variance rather than the constructs or the questions being asked (Bell, 2019). The CMV may also occur when independent and dependent variables share commonalities as a result of a single source. Moreover, CMV can be caused by respondents who provide a similar answer to scales that are not otherwise related. For instance, a long questionnaire survey can be a source of bias because when a respondent gets tired, he or she is not willing to act truthfully and starts providing responses that are consistent with certain scale measures (i.e. 5 in all measurement items). Consequently, the reliability and validity can be compromised.

A study by Rodríguez-Ardura and Meseguer-Artola (2020) suggests that other potential sources of CMV include a respondent's limited ability to respond to the scale items, scale items' complexity, items' ambiguity, items that require retrospective recall, the respondent's lack of experience of thinking about the topic at hand, the respondent's low involvement in the topic, the salient positioning of scale items of a criterion construct (so respondents infer that there are causal relationships with other constructs) among others. Bell (2019) and Rodríguez-Ardura and Meseguer-Artola (2020) propose two approaches to reduce CMV and include procedural remedies (ex-ante methods), which seek to reduce the potential of CMV, or statistical remedies (post hoc), which seek to identify whether CMV exists in the data set collected.

The current study used a variety of sources to gather information related to measured constructs. The questionnaire wording was concise, accurate and easy to understand. The pilot test helped to remove all ambiguities before the effective collection of data process commenced. The measurement items were related to GSCM, SCDCs and SCP. Since the survey was self-administered questionnaires, the anonymity of respondents was guaranteed. Respondents were briefed that there are no correct or wrong answers to alleviate the pressure they may have felt in completing the questionnaires. Respondents were assured that research data will not be disclosed to the public or any other unauthorised persons. Only the supervisor, statistician and the researcher had access to raw data. The statistician was asked to sign a non-disclosure agreement form supplied by UNISA.

Moreover, the study conducted two additional tests. First, the Harman's one factor test was performed by using the principal component analysis in SPSS with unrotated factor solution on the 5-point scales of all measurement items. The presence of substantial CMV was not evident since a single factor did not emerge from the factor analysis or one general factor did not lead to most of the covariance among the measures (Tehseen *et al.*, 2017). Secondly, the CFA maker techniques using SEM was used to detect and eliminate undesirable effects of CMV. The CFA technique consisted of introducing maker latent variables with maker scale items that shared similar characteristics with those that measure relevant constructs.

5.12 PROCEDURES FOR DATA ANALYSIS

Data analysis can be described as a process of exploring, cleaning and consolidating information collected from respondents for a statistical analysis (Aneshensel, 2015). Collected data need to be cleaned for errors, inconsistencies and ambiguities to allow further statistical evaluations (Paterson, 2016). The importance of data lies on optimising their usefulness and accuracy. Once data bear characteristics that enable and facilitate their statistical analysis through data preparation and normality tests, they are processed using descriptive and inferential statistics as well as SEM. These tests were conducted through the Statistical Package for Social Sciences (SPSS version 25.0) and Smart – Partial Least Squares 3.

5.12.1 Data preparation

Real-time data are generally unorganised and filled with errors and inconsistencies that affect statistical analyses. Data preparation consists of streams of actions aimed at improving the accuracy of collected data in a way that gives them a statistical significance (Paterson, 2016). In the study, the data preparation process included data editing, data coding and data cleaning.

5.12.1.1 Data editing

Data editing can be described as a process of identifying omissions, ambiguities and mistakes in responses from collected survey questionnaires (Diamantopoulos & Schlegelmilch, 2000). Data editing helps mitigate and reduce the level of mistakes in data matrix questionnaires during and after the data collection process. Moreover, editing has the potential to improve the quality and accuracy of data through adequate quality control (Pfeffermann & Rao, 2009). The current study ensured that the collected data were useful and free from errors that could compromise the integrity of the statistical analysis. Detected errors that may have affected the validity of the test were removed (i.e. non-numerical answers) and inconsistent values (i.e. type of data and nature of the field) as well as outliers (i.e. unusual, or extreme values) were adjusted or removed after comparison with original questionnaires. These operations ensured that the overall accuracy of the collected data was improved to facilitate further statistical assessments.

5.12.1.2 Data coding

Data coding consists of formatting collected data to facilitate access by statistical computer programmes to avoid data errors (Newton & Rudestam, 2017). Huxley (2020) stresses that data coding represents a cognitive process that allows the researcher to identify relevant information by assigning it a unique code. In the study, each questionnaire received from respondents was given a unique identification number that facilitated their computerisation. These numbers ranged from 001 to 402 and were organised and presented in the Microsoft Excel spreadsheet. Response questions were also allocated unique identification numbers that facilitated their population into the spreadsheet. For instance, the value that related to the gender was assigned 1 to males and 2 to females instead of “M” for males and “F” for females. The study did not give two code variables the same number. Code variables were labelled to help remember what they stand for in the codebook designed for this purpose. All codes that related to the same issue in the questionnaire were coded in such a way that low values expressed a low level of intensity and high values expressed high level of intensity. Since the questionnaire of the study was closed-ended, provisions were made to cope with questions that did not fit into the “other” categories that was created. Once the coding was completed, the researcher scanned the spreadsheet for errors. This task ensured that each variable labelled or was allocated a unique number was linked to the questionnaire.

5.12.1.3 Data cleaning

Mistakes are likely to happen when typing information into the computer. Such mistakes include skipping rows, typing the same number twice, or entering a “ghost” number (where the space should have been empty). Data cleaning involves a process of producing high-quality information by eliminating any form of errors to guarantee the effectiveness of the statistical analysis (Ruel *et al.*, 2018). This stage of data preparation plays an important role since it allows to identify, refine and fix irregularities in the collected data. Few mistakes such as value entry mistakes, missing values were found and prompted the revision of the questions with reference to the original questionnaire with the aim of optimising the data analysis process. Moreover, the SPSS syntax, which is a programming language that facilitates the identification of errors as well as corrupt and missing data was used. The software conveniently facilitated the correction of irregularities by automatically pasting syntax from a point-and-click dialog box to the output window whenever a command was executed. This software also kept records of all data manipulation operations and allowed to keep the trend of where most of the errors derived.

5.12.2 Tests for normality of data

Tests for normality involve a routine assumption made in the development and use of statistical analyses (Belhekar, 2019). The properties of a normal standard distribution [0; 1] include similar mean, mode and median, the curve is symmetric, the highest frequency is in the middle as well as zero skewness and kurtosis (Antonius, 2017). The test of normality is performed in two ways, which include the statistical tests and the test using graphics. Statistical tests generally involve testing the hypothesis that the sample comes from, which is normally distributed whereas graphical representations are more concerned about using the properties of the normal distribution to plot data (Diamantopoulos & Schlegelmilch, 2000). This provides effective diagnostic tools to confirm assumptions. According to D'Agostino (1986), as cited by Belhekar (2019), an effective way to perform a normality test is to combine statistical and graphical methods. This can help make an effective judgement to verify distributional assumptions.

Moreover, a study by Belhekar (2019) identifies a variety of techniques used to test the normality of data. The statistical tests include those that utilise moments (i.e. mean, variance, skewness and kurtosis), goodness-of-fit criterion (i.e. Kolmogorov- Smirnov test, Shapiro-Wilks test, Jarque-Berra test, The D'Agostino–Pearson Test Anderson-Darling Test, Cramer-von Mises Test and Kuiper's V test) and the R codes while graphical representations comprise raw data plotting methods (histogram, stem-and-leaf plot, boxplots or box-and-whisker plots), probability plotting methods (P–P plot, Q–Q plot), detrended probability plots (detrended Q–Q plot) and empirical cumulative distribution function (ECDF).

The variance-based SEM – PLS (Smart-PLS 3) was used to test normality and the identification of distributional characteristics is presented in Table 6.20. Data collected from respondents were administered to develop normative scores. For instance, the average norms were developed and used as the reference point or cutting measure against which any individual score was compared. Any measure found to fall outside the cutting score was considered not meeting the normality test requirements. The results for the testing of data normality are reported in Section 6.6.

5.12.3 Descriptive statistics

Descriptive statistics represent a process that describes data numerically (Mertler, 2017). Descriptive statistics are used to evaluate the shape of a distribution and include measures of the central tendency (mean, median and mode), variability (range, variance and standard deviation) and the skew (Scherbaum & Shockley, 2019). Moreover, descriptive statistics create numeric summaries and organise large numbers of observations to describe data and make sense of them. Summarising and reducing data into some meaningful statistical results allow data to be interpreted (McGregor, 2019). Various measures of descriptive statistics which include frequency distributions, mean scores, standard deviations and percentage are available. Data that were collected from sections A and B of the survey questionnaire in Appendix 1 which sought to establish the profile of South African manufacturing companies participating in the study and the demographic characteristics of respondents were analysed using descriptive statistics which included frequency distribution, mean scores, standard deviations and percentage. The results for descriptive analysis are presented in Section 6.3.

5.12.3.1 Frequency distribution

The frequency distribution represents a descriptive analysis that provides information about the number of observations of each observed value of a variable as well as the frequency of missing data (Scherbaum & Shockley, 2019). Moreover, Scherbaum and Shockley (2019) postulate that frequency analysis provides information regarding the cumulative number of observations and their percentage. The frequency analysis was performed on sections A and B of the survey questionnaire which sought to provide information about the profile of manufacturing firms across four provinces in South Africa as well as on the total number of observations. For instance, frequencies pertaining to gender, industry, age, response data and among others were provided in tables in Section 6.3 and their results discussed thereafter.

5.12.3.2 Mean scores

The mean, also known as arithmetic mean, is the measure of the central tendency in statistical analyses and research reports (Leedy & Ormrod, 2015). The mean describes the arithmetic average of a set of data. It is computed as the sum of the data for a variable divided by the sample size (Mertler, 2017; Scherbaum & Shockley, 2019). In the study, evidence on respondent's perceptions in line with GSCM, SCDCs and SCP was analysed through the mean. The results of this analysis served as an indication of how well (or poorly) the practices of GSCM were performed as well as their influence on SCDCs and the level of performance of the supply chain. The overall mean score for each construct under consideration in the study was provided along with their position in the rank.

5.12.3.3 Standard deviations

Standard deviations are measures of the variability of data from the mean (Mertler, 2017; Scherbaum & Shockley, 2019). The magnitude of standard deviation was evaluated in comparison to the value of the mean and the expected variability. Small values of standard deviations are desirable since large values indicate little probability of making a correct guess about where any data point lies. In the study, the response data provided the study with an indication on how spread out or concentrated responses were in relation to the mean.

5.12.3.4 Percentages

The percentage allows a researcher to compare one or more variables standing to others (i.e. scores, rank). It tells where a variable stands relative to a reference group (McGregor, 2019). Moreover, a percentage simplifies data by reducing all number to a range from 0 to 100. It also translates data into standard form with the base of 100 for relative comparison (Blumberg *et al*., 2014). In the present study, the percentage helped to determine the response rate (in relation with the number of responses and total number of respondents), the industry classification rate, gender and age's rate and among others.

5.12.4 Inferential statistics

Inferential statistics describe the process that allows to draw a relationship about a large population found from a relatively small sample (Leedy & Ormrod, 2015). It is important to emphasise that the main goal of inferential statistics is to determine how likely a given statistical result of a sample is representative of the entire population (Mertler, 2017). Information collected from section C to section E of the survey questionnaire in Appendix 1 which attempted to test hypotheses was analysed using inferential statistics. Fifteen hypotheses under consideration in the study were tested to see whether they were consistent with data collected from respondents representing South African manufacturers across the four provinces of interest.

Moreover, the parameter estimation was also conducted through the mean, standard deviations as well as the proportion of the acceptable sample size within South African manufacturers. This allowed to draw conclusions about the characteristics of the sample. These tests were conducted through SPSS version 25.0 and Smart-PLS. The relationships between the research constructs were determined using SEM. CFA was used to test the accuracy of the measured variables. The exercise helped in determining the model fit and answering research questions using Smart-PLS 3.

5.12.5 Exploratory Factor Analysis

Exploratory factor analysis can be defined as a theory-driven technique that attempts to test whether observed variables from the survey questionnaire fit the theoretical model developed from the literature review (Belhekar, 2019). EFA technique has the role of exploring the correlations between all variables and uses them to identify a new one (i.e. factor) made up of combinations of all the original variables which account as much of the variation in the data as possible. It further identifies a second factor that accounts for as much of the remaining variation and so on until all the variation is explained (Dawson, 2018). Moreover, Haig (2018) stresses that the ultimate goal of EFA is to describe the underlining structure in an economic manner by hypothesising a small number of factors or latent variables that are thought to underlie and give rise to the pattern of correlations in new domains of manifest variables.

The current study used EFA to validate the survey questionnaires and determine the factorial structure of data collected from respondents on the implementation of GSCM and its impact on DCs and SCP. It is important to emphasise that EFA can help determine the number of common factors for a set of variables and the identity of their underlining structure (Vintilă & Tudorel, 2018). Additionally, EFA assessed the consistency between observed variables and the factor structure proposed in the current study’s conceptual model. This allowed to determine which items should go with each construct through exploration (EFA) and testing of predictions. It is also important to emphasise that EFA technique reduces a complex set of variables into a lower number of factors. For example, all items in the questionnaire loaded in one or more factors.

Moreover, EFA provided a set of more formal test methods that were used to assess and determine the underlying structure of the collected data through the survey questionnaires. These methods are discussed in the following sections and provide some insights into EFA's procedures.

5.12.5.1 Factorability of correlation matrix

A correlation matrix plays an important role in checking the suitability of the collected data through the factorability in order to perform the EFA technique. The correlation matrix generally refers to the observed correlations between variables from collected data (Belhekar, 2019). The test provided information about the significance of the correlation between observed variables from the survey questionnaires to allow for dimensionality reduction. Factorability tests included the Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO). These tests were used to measure sampling adequacy (Belhekar, 2019).

5.12.5.1.1 Bartlett's test of Sphericity

The Bartlett's Test of Sphericity helps determine if the data collected from the respondents are factorable. Moreover, the test is sensitive to sample size and increases in power as sample size increases. This technique is suitable to test a null hypothesis to demonstrate that variables are uncorrelated with each other. A significant p-value which is $p < 0.05$ suggests that there is no problem with the sampling adequacy (Dawson, 2018). Moreover, the Bartlett's Test determines that the population correlation matrix is an identity matrix. Identity matrix has unities on diagonal spaces and zeros in off-diagonal spaces.

5.12.5.1.2 Kaiser Meyer Olkin Measure of Sampling Adequacy

The Kaiser Meyer Olkin (KMO) can be described as an indicator of data appropriateness, which helps analyse the adequacy of samples (Dawson, 2018). The KMO index indicates the contribution of partial correlations to the ratio of correlations. Small partial correlations are functions of a common variance in the correlation matrix. As a rule of thumb, the measure of KMO always varies between 0.0 and 1.0 with the minimum score of 0.6 indicating the appropriate level of the sample adequacy (Dawson, 2018).

The collected data were screened for factorability using the Bartlett's Test of Sphericity and KMO. The Bartlett's Test established whether the correlation matrix was an identity matrix. A significant p-value which was $p < 0.05$ suggested that the variables in the correlation matrix were related, thus suitable for the EFA. The KMO technique helped to determine whether the sample size was adequate for the present study. During the analysis of the sample using KMO, any estimates below 0.6 indicated the inadequacy of the sample size. The results are provided in Section 6.4 of the thesis.

5.12.5.2 Principal Components Analysis

Principal Components Analysis (PCA) examines the correlations between variables to detect the underlying patterns that may affect the determination of the structure in the data (Dawson, 2018). The PCA is a statistical technique that converts observed correlated variables into latent uncorrelated variables that maximise variance (Hutcheson, 2020). For instance, in the current study, the use of PCA was witnessed in the identification of the implementation of GSCM through the survey questionnaire in which questions and answers were related. Questions of a questionnaire may lead to ascertain that a respondent of a particular company is practicing environmental sustainability where environmental sustainability is not a single measurable entity but rather a construct which derives from measurement of other, directly observed variables. In other words, environmental sustainability is not a direct observed variable, but a construct inferred from the relationships in the data. The method is used to reduce a large number of variables to a small number that enables data to be easily analysed (Hutcheson, 2020). The PCA produces components that identify the linear combination of variables that explain the variance in the data through interpretation of the results (Hutcheson, 2020).

In the present study PCA was used to reduce the dimensionality of the collected data while preserving their variability (finding new variables) as possible. Reducing the collected data to a small data made it easier to explore and visualise. The technique used SPSS and was performed on a standardised 5-point scales. The analysis of the components provided information about the amount of variance in all data that is accounted for by each component. The study selected those components that individually accounted for a variance above 1.0 (Hutcheson, 2020). The scree plot was also used to investigate and select components (Blunch, 2017). Refer to Section 6.4.1 and 6.4.2.

5.12.5.3 Communalities of variables

A communality can be described as a measure of a variance of each item that is shared with other items as opposed to that which is unique (Dawson, 2018). Boedeker and Henson (2020) also define a communality as the sum of a variable's squared structure coefficients across all retained functions. Factor analysis uses variance (uniqueness and extraction) to produce communalities between variables, where the variance is equal to the squared of factor loadings (Yong & Pearce, 2013). In the factor analysis, extraction plays the role of removing as much as common variance in the first factor as possible. Communality can be expressed as the variance in the observed variables which are accounted for by a common factor or common variance.

In addition, variance is also recognised by its uniqueness in factor analysis, which is the proportion of the variance that excludes the common factor variance. The unique variance can be split into two portions, which include the specific variance and the error variance, the latter referred to as the unreliability of the variance (Belhekar, 2019). The communality, the specificity and the unreliability comprise the total variance of a variable. The unique variance is not correlated with the common factors. However, the common factors may be uncorrelated or correlated with each other (Yong & Pearce, 2013). Generally, the cumulative percentage of variance is extracted after each factor is removed from the matrix and this cycle continues until approximately 75-85% of the variance is accounted for (Yong & Pearce, 2013). The percentage variance indicates how much each factor contributed to the total variance.

In the current study, the communalities of all measurement items from the questionnaire were analysed (refer to Tables 6.13 & 6.15). The initial communalities showed the amount of variance in an item which is shared with other items while the extracted communalities showed the proportion of variance that could be explained through the extracted item. The initial communalities helped determine which item should be included in the analysis. Throughout the analysis if an item was identified as having very low scores of communalities than other items, it suggested it may not be part of the analysis (the study provided a cut-off estimate of 0.3). Yong and Pearce

(2013) suggest that variables with high communalities are desirable and those with low communalities (less than 0.3) should be eliminated from the analysis since the main purpose of factor analysis is to explain the variance through the common factors. Therefore, measurement items with low communalities were removed.

5.12.5.4 Rotation techniques

Rotation techniques can be described as a process of making the selected components simpler and more interpretable (Belhekar, 2019). Belhekar (2019) classifies rotation techniques into orthogonal rotation (Varimax) and oblique rotation techniques. These techniques attempt to provide a solution with the best simple structure of data. Varimax (orthogonal rotation) produces factors that are not correlated while oblique rotation technique produces factors that are correlated (Belhekar, 2019). Generally, varimax involves adjusting the coordinates of data that result from a PCA (Allen, 2018). The adjustment, or rotation is intended to maximise the variance shared among items (variables). By maximising the shared variance, results more discretely represent how data correlate with each principal component. Maximising the variance generally means to increase the squared correlation of items related to one factor, while decreasing the correlation on any other factor (Allen, 2018).

The current study ran the Varimax technique after all data were collected from respondents across the four provinces. The test attempted to categorise variables on the selected set of factors. This implied clarifying the relationships between factors by attempting to maximise the loading of each variable on an individual factor while limiting the loading on other factors. By so doing the study was able to determine the factors that tend not to correlate very highly with each other (i.e. minimal or no correlation).

5.12.5.5 Factor loadings

Factor loadings refer to the coefficient that describes the unique relationship between an observed variable and a factor (Belhekar, 2019). In other words, factor loadings represent a measure of the amount of variance in any particular item that is caused by the latent factor, so any squared loading is the variance in that item that is explained by the factor. Higher factor estimates are satisfactory for item loadings. The present study turned into Lestari's (2019) rule of minimum loading of 0.50 to establish to minimum acceptance loading. Allen (2018) postulates that this rule is intentionally conservative to keep the resulting factors pure and should only be used with varimax (orthogonal) rotation.

In the current study variables with the strongest association to the underlying latent variables were identified. Factor loadings generating a minimum loading of 0.50 were retained.

5.12.5.6 Factor retention

The decision about how many factors to retain is vital in EFA. The result of a factor analysis is a model retaining between 1.0 and n factors, where n is the number of indicators entered into the model. The goal of the process of factor retention is not to find the correct solution, but rather the best solution. In all modelling with latent variables, there are many potential correct solutions, but they are not all equally interpretable. Allen (2018) identified three methods to help make an informed decision about which factor structure to retain. These methods include the Kaiser rule, the Cattell's scree test and the Horn's parallel analysis. These three procedures are not equal in their effectiveness and should always be used to inform the assessment of interpretability and theoretical adequacy of the retained solution (Allen, 2018).

The Kaiser rule establishes that only factors with eigenvalues greater than 1.0 should be retained. In factor analysis, the eigenvalue represents the amount of variance across the indicators that the factor accounts for. The Cattell's scree test involves a visual examination of the scree plot of the eigenvalues of extracted factors. The criterion for retention involves identifying the break point at which the scree begins and retain only factors that do not belong to the scree (Allen, 2018). The Horn's parallel analysis has been demonstrated to be the most consistent factor-retention criterion. Parallel analysis is a procedure that compares the measured eigenvalues from the data matrix against a Monte-Carlo simulated matrix of random data of the equivalent size. Researchers should retain only the factors that have higher eigenvalues than the equivalent factors in the random data matrix (Hayton *et al.*, 2004).

It is important to determine the factor retention in statistics since too few or too many factors could affect the reduction and the interpretation of information in the data set. In the current study, the factor retention was ascertained through the Kaiser rule and the Cattell's scree test. The Kaiser rule consisted of retaining factors with eigenvalues greater than 1.0. Moreover, as rule of thumb, Hayton *et al*. (2004) suggest that the reliability of a component must always be nonnegative when its eigenvalue is greater than 1.0. The criterion of retention of the Cattell's scree test consisted of visually identifying the break point at which the scree begins and retain only factors that did not belong to the scree.

The results revealed by the EFA were further assessed using the CFA. CFA analysed hypotheses related to the degree to which the solution suggested by EFA was appropriate. This implied that items on the survey questionnaire were effectively related to specific factors. The results for the EFA are reported in Section 6.4.

5.12.6 Structural equation modelling

It is suggested that SEM helps to accurately define research problems in relation with the phenomenon under investigation, formulate clear objectives and hypotheses, provide precise definitions of the selected research constructs and initiate the investigation to find the relationship between variables (Tarka, 2017). SEM can be defined as a set of mathematical equations that uses parameters in the analysis of observed variables (Tarka, 2017). In other words, SEM is a technique that quantifies the cause-and-effect relationship between observed variables. Furthermore, it allows to answer a set of interrelated questions in a single, systematic and comprehensive analysis by modelling the relationships among multiple independent and dependent theoretical constructs simultaneously.

A study by Kevin (2017) stresses that SEM is a confirmatory technique to assess theory-derived causal hypotheses. It deals with the statistical estimation of relationships between factors of variables, tests complex structural models on the interrelationships between latent variables and assesses the direct and indirect effect of independent variables on dependent variables. SEM involves determining the various directed and undirected relationships among the latent and observed variables as well as the errors of the endogenous variables (Kevin, 2017; Bauldry, 2020).

The current study used SEM, based on the SMART-PLS technique to test the relationships between the research constructs developed from the literature review and presented in the study's conceptual framework in Chapters 1 and 4 in which it was predicted that the implementation of GSCMPs leads to enhance SCDCs, which in turn impact the SCP in the South African manufacturing sector. This provided explanations and empirical verifications of the importance of the implementation of GSCM that can be used to advance research studies in the field of SCM. SEM was used because of its ability to help quantify the cause-and-effect relationship between observed variables.

The results for the application of the SEM procedure are presented in Section 6.8. In addition, the study used 0.05 significant level to produce the standard error as recommended by Çakıt et al. (2020) and Ferine et al. (2021). If $p < 0.05$, the hypothesis is supported, otherwise it is deemed rejected. The path coefficients and p-values were calculated using Smart-PLS.

5.12.7 Pilot study

A pilot study can be described as a preliminary phase of a research that allows the researcher to identify early potential design related issues (inadequacy of the questionnaire, research approach and technique limitations, research protocols not enabling to answer the research questions and among others) for their possible improvement before embarking on the main study (Gutiérrez *et al.*, 2018; Sternberg, 2019). The pilot study involved collecting preliminary data from respondents to test for validity and reliability of the questionnaire. This was done in order to prepare the researcher in conducting the actual study. Moreover, the pilot study helped to understand the procedural requirements involved in the main study and also assisted in selecting appropriate methods and techniques that were beneficial in answering research questions (In, 2017).

As a rule of thumb, Winger, Kelleher, Fisher, Somers and Samsa, (2022) recommend a sample size of between 10 and 75 respondents per study condition to estimate the parameters since there is no single way of determining the sample size of a pilot study. Data were collected conveniently from supply chain professionals across the four provinces of interest. Based on the recommendation, the sample size of the pilot study was pegged at 10 per cent of the effective sample size (500) for the study. Fifty (50) online questionnaires were distributed to supply chain professionals in Gauteng (38), Mpumalanga (7), Free State (4) and Limpopo (1) prior to the commencement of the main study. The quota sampling was based on the relative contributions of manufacturing companies to the South African manufacturing sector presented in Table 5.3 of Chapter 5. The selection criterion of respondents was based on the knowledge and experience in supply chain and involvement in supply chain activities.

The focus was mostly on testing questions related to the implementation of GSCM practices, SCDCs, and SCP. From 50 questionnaires that were returned, 5 were discarded because of missing data and only 45 were processed since they were complete and valid. Chapter 6 provides the results of the pilot study.

5.13 SCALE ACCURACY ASSESSMENT

The accuracy of the measurement sale was tested using the CFA procedure. CFA is a theory testing procedure which is executed through the SEM, a sophisticated statistical technique for testing complex theoretical models on data (Prudon, 2015; Reinecke & Pöge, 2020). CFA allows to test a theoretical model with given measurement hypotheses (Reinecke & Pöge, 2020). Moreover, CFA allows the use of a hypothesised model to estimate a population covariance matrix that is compared with the observed covariance matrix (Reinecke & Pöge, 2020). It is important to stress that observed variables were statements that derive from the five-point Likert scale adopted by the study; whereas latent variables were variables that could not be directly measured such as perception and motivation (Frey, 2018).

To ensure the adequacy of the instrument to measure research constructs and since a poorly developed questionnaire may not provide information that can help respond to research questions, the reliability and validity tests of the questionnaire were ascertained through the CFA. These two approaches to instrument measurement helped determine the ability of the questionnaire to effectively capture the concept of the implementation of GSCM in the South African manufacturing sector across the four provinces of interest. They also helped to demonstrate if the questionnaire was efficient, convenient and easy to understand and use by respondents. CFA also allowed the estimation of the model fit with goodness-of-fit measures.

5.13.1 Reliability

Reliability can be defined as the ability of an instrument to measure with accuracy what it is supposed to repeatedly and it is often understood as a precondition for validity (Marquart, 2017). Reliability also refers to the consistency of the measurement to produce identical results (Frey, 2018). Marquart (2017) further argues that the reliability assesses internal consistency of a test by ensuring that variations stay within the required score range of the measured concept and the observed scores. Blunch (2017) suggests that the ultimate goal of this test is to keep the score as small as possible (i.e. minimising the error score with the reliability estimates range from 0.0 to 1.0). Frey (2018) identifies various tests of reliability estimates which include the test-retest reliability, parallel forms, split-half estimate, Cronbach alpha, Kuder-Richardson reliability, scorer reliability, item total correlations and estimate of reliability in criterion-referenced tests. In the current study, the reliability was ascertained through computer-based techniques which included the item-total correlation, Cronbach alpha, Rho_A and Composite Reliability (CR) since the study intended to evaluate the homogeneity, reproducibility and the stability of measures. Ample information is provided in Section 6.8.

5.13.1.1 Internal consistency

Internal consistency of scores is a measure of the extent to which respondents used the questionnaire consistently and the extent to which scores consist of random measurement errors (Frey, 2018). Basham *et al.*, (2019) identify three types of internal consistency reliabilities, namely the split-halves reliability, the Cronbach's alpha and the Kuder-Richardson coefficients. The split-halves reliability consists of comparing two sets of questionnaires that are functionally equivalent to see how answers are similar across the halves of questionnaires. The Cronbach alpha coefficient is a commonly used technique to estimate the reliability of an instrument (Schmidt & Hunter, 2017). Values of the Cronbach alpha coefficient closer to 1.0 are desirable, with commonly accepted heuristic values of 0.60 and above (Ferine *et al*., 2021; Kholed *et al.*, 2021). While the Kuder-Richardson coefficient is used for items that have varying characteristics (Basham *et al*., 2019).

Moreover, a study by Hair *et al.*, (2017) suggests that since Cronbach's alpha is plagued with limitations in its application as a result of its sensitivity to the number of items in the scale and generally tends to undermine the internal consistency reliability; consequently, it will be technically appropriate to supplement or substitute it with the composite reliability (CR). CR can be described as a measure of internal consistency in scale items (Hair *et al*., 2017). CR scores vary between 0 and 1 with scores close to 1 highly desirable since they indicate higher reliability. CR scores between 0.70 and 0.90 will be deemed satisfactory. Scores above 0.90 (i.e. 0.95) were not desirable because they indicated that all indicator variables were measuring the same phenomenon and were therefore not likely to be a valid measure of the construct. Such higher values are the result of errors and generally occur when a researcher uses systematically redundant items by slightly rephrasing the same question (Hair *et al*., 2017). Internal consistency was ascertained using Cronbach's alpha and CR. Therefore, the accepted Cronbach alpha coefficient was equal or greater than 0.60 and CR scores between 0.70 and 0.94 were deemed satisfactory.

5.13.1.2 Item-total correlations

Item-total correlation is a measure of reliability that seeks to establish the relationship between two latent variables (Blunch, 2017). It represents the simple correlation between the item and the sum of the rest. As a rule of thumb, Seydi *et al.* (2021) and Ozsahin and Derya (2022) suggest that items that exhibit the minimum score of 0.30 are deemed satisfactory. Assessments above this threshold score indicated a higher probability of responding to any given item correctly. Moreover, the pilot test was also performed in order to assess the preliminary reliability of the measurement instrument. During the pilot test, items found to constitute a poor contributor to the reliability test, were revised or removed from the questionnaire.

5.13.2 Validity

Validity refers to the extent to which an instrument adequately reflects what it is designed to measure (Frey, 2018). Blunch (2017) further stresses that the instrument under assessment should be valid. In other words, it should measure exactly what it is intended to measure. There are five approaches to empirical validity of an instrument such as face validity, content validity, criterion-related validity, construct validity and factorial validity (Frey, 2018). Blunch (2017) also classifies the assessment of validity into content validity, criterion validity, construct validity, convergent validity and discriminant validity. Validity coefficients tend to be smaller than reliability coefficients and normally range between 0.40 and 0.60 (Blunch, 2017). The study investigated whether the scores from the measures correlate with scores from other measures hypothesised to be related to (or not related to) the measure of interest. The test validity comprised face validity, content validity, construct validity, convergent validity and discriminant validity. The test of validity firstly featured the ability of the survey questionnaire to capture the implementation of GSCM and secondly, the ability of the findings to be generalised across the manufacturing sector in South Africa.

5.13.2.1 Face validity

Face validity is a judgment that an operational definition appears in the measurement (Frey, 2018). Face validity can also be explained as the ability of an evaluating panel to think that the test is measuring what it is supposed to measure (McGregor, 2019). In the present study, face validity was ascertained by a panel of supply chain professionals. The panel comprised the research supervisor of the current study, a quality manager, a managing director and one logistics manager. These experts had intensive knowledge and experience in supply chain management. Their feedback helped to refine the questionnaire and improve the accuracy of responses.

5.13.2.2 Content validity

Content validity refers to the assessment of the content of the measurement based on the solicited opinions of the researchers and experts (Frey, 2018). Blumberg et al. (2014:400) also define content validity as the extent to which an instrument provides adequate coverage of the investigative questions guiding the study. The content validity was evaluated through a pilot test that included a small group of respondents such as a quality manager, a managing director and a logistics manager to check for weaknesses and ambiguities. This exercise helped respondents to get familiarised with the research protocol and understand research expectations. The pilot test ensured that formatting and typographical issues were dealt with as well as all aspects of GSCM concepts to answer research questions were covered. Respondents at this stage of the study were selected conveniently and purposively as a result of their knowledge of SCM, quality and operations management. Furthermore, this convenient method was cheap and respondents are found easily. The feedback from the pilot test allowed to refine the questionnaire through the removal of all shadowed areas for clarity before the effective commencement of data collection.

5.13.2.3 Construct validity

Construct validity refers to the extent to which a measure relates to other variables within a system of theoretical relationships (Frey, 2018). Construct validity also refers to the ability of a measurement tool to measure the specific theoretical construct it was designed to measure (Blunch, 2017). This test assessed the corresponding link or the adequacy of the relationship between the empirically grounded theory and the measuring instrument. In other words, the performance of the survey questionnaire with respect to theoretical expectations were evaluated. Such an approach provided the present study with preliminary indications of convergence and discriminant validity tests. These tests involved determining similitude and differences with well-established measures (concepts).

5.13.2.4 Convergent validity

Convergent validity is mostly based on similitude. This logical inference is concerned, for example, with the overlap between theories. Reinecke and Pöge (2020) postulate that convergent validity proves that constructs that are expected to be related are, in fact, related. Convergence validity is established using the factor loading of the indicator, the CR and the average value extracted (AVE). It is important to mention that item-loadings greater than 0.3 are deemed to be acceptable (Seydi *et al*., 2021; Ozsahin & Derya, 2022). The AVE should equal or greater than 0.5 in order to indicate adequate convergent validity (Hamid *et al.*, 2017). Convergent validity was ascertained using factor loading and AVE. Throughout the current study any value below 0.5 was rejected since it defeated the purpose of the factor loading which is to ensure the integrity of the test. Additionally, the AVE scores equal or greater than 0.5 were deemed satisfactory since they met the convergent validity requirements.

5.13.2.5 Discriminant validity

In contrast to convergent validity, discriminant validity is concerned about the level of differentiation of two theories, for example. Discriminant validity provides evidence in a sense that constructs that should not be related do not in fact have any relationship whatsoever (Reinecke & Pöge, 2020). Allen (2018) ascertains that a researcher who is interested in determining the discriminant validity would propose that, for example, two theories are different. Allen (2018) further stresses that discriminant validity may also seek to demonstrate that a construct describes unrelated factors evidenced by the discriminant analysis. This is often statistically demonstrated by a low correlation between variables. Discriminant validity of constructs was ascertained using the Fornel and Larcker criterion which compared the square root of each AVE in the diagonal with the correlation coefficients for each construct in the relevant rows and columns (Çakıt *et al*., 2020).

5.13.3 Model fit analysis

Various fit assessment tools are used to demonstrate the manner of which the conceptual model fits the collected data (Kevin, 2017; Allen, 2018; Frey, 2018). Each statistical test gives an indication of how well (or poorly) the model-implied covariance matrix reproduces the observed matrix (Allen, 2018). The overall fit of the model was assessed through the features generated by Smart PLS which included the standardised root mean square residual with (SRMR) and the normed fit index (NFI) presented in Table 6.25 of Chapter 6. Generally, SRMR values should be between 0.08 and 0.10 to avoid model misspecification (Dash & Paul, 2021; Hasan & Bao, 2021). The model is considered perfect fit when SRMR is close to 0. Furthermore, it is recommended that the NFI falls between 0 and 1 and the more it approaches 1 the better the model fit (Nguyen & Habok, 2021).

Table 5.6: Model fit indicator's recommended confidence intervals.

Model fit indicators	Confidence intervals
SRMR	≥ 0.100
NFI	≤ 0.95

Source: Dash and Paul (2021); Hasan and Bao (2021); Nguyen and Habok (2021).

Table 5.6 shows the model fit indicators that were used to establish the extent to which the distribution of variables follows some pre-specified functional form in the population. The result of this assessment demonstrates that the study's conceptual model fits the collected data. The fit was assessed through the NFI and SRMSR.

5.13.3.1 Path analysis

The path analysis can be defined as a type of SEM that tests the relationship between observed variables (Kevin, 2017; Allen, 2018). The concept behind the path model involves justifying relationships between variables of interest in the conceptual framework developed from previous research works. The path analysis allows the study to test the direct, indirect and total effects of variables simultaneously and provide the overall goodness-of-fit measure for the model (Schumacker & Lomax, 2016). The path analysis was tested through Smart-PLS and the relationships between observed variables were quantified through the path coefficients. The model was hypothesised to test causal relationships between GSCMPs (independent variables) and SCP (dependent variables) through the mediating role of SCDCs (mediating variable). The model specified only the paths among the variables of interest in the study. A more in-depth discussion is provided in Section 6.8.

5.14 MEDIATING VARIABLE AND ANALYSIS

A mediating variable explains and identifies the causal process that underlies the relationship between two variables (Alfons, Ates & Groenen, 2021; Di Maria, Abbruzzo & Lovison, 2022). Furthermore, a mediating variable intermediates the causal effect that relates independent variable to outcome variable in such a way that the former produces an effect on the mediating variable which in turn impacts the outcome variable. Mediating variables are also known as intervening variables or intermediate variables because they come between independent and outcome variables (Miocevic, Moeyaert, Mayer & Montoya, 2022). Important aspects of mediating variables are their close link with the theory and the potential that the mediating variables identified in one context may operate in a wide variety of contexts. The current study identifies SCDCs as adaptative capability, absorptive capacity, and innovative capability; all these three dimensions were grouped into a single research construct configured as SCDCs, suitable to compete and achieve sustainable competitive advantage in a dynamic environment.

5.14.1 The mediating effect.

In research projects, mediating analysis is viewed as a process of testing the relationship between two variables i.e., independent and outcome in presence of mediating or intervening variable (Sidhu, Bhalla & Zafar, 2021). SCDCs in the study convey an indirect effect of GSCM practices to SCP. The study focused on the indirect effect which is the effect of the independent variable on the outcome through the mediator (SCDCs). This is consistence with one of the objectives of the study which is to evaluate how SCDCs play the role of intermediate variable in the mechanism through which GSCM practices affect SCP. For this study, the mediating effects of SCDC were evaluated through Smart-PLS by examining the significance of the standardised indirect effects. If the indirect effect is significant ($p < 0.05$), it means that the intervening variable which is referred as SCDC is completely mediating the relationship between GSCM practices and SCP in the South African manufacturing sector. Table 6.28 of Chapter 6 provides the results of the mediation analysis of SCDC.

5.15 ETHICAL CONSIDERATIONS

Research studies are not only concerned with the generation of knowledge but also with the ways in which data are collected that implicate research communities at large.

The latter raises questions of respect of ethical and moral principles during and after the inquiry process since the outcome of the studies may have some impact (i.e. conflict of interest) on respondents (Paterson, 2016). This section provides an overview of some ethical issues as described by Yuko and Fisher (2015) that may have arisen from the current research project and ways to tackle them. The ethical position was constantly reviewed, and the transparency was maintained as well as professionalism with respect to the following guidelines:

5.15.1 Informed and voluntary consent

Respondents were provided with information necessary to ensure that they could make an informed decision to accept or to reject their participation in the study. Respondents provided automatic consent by completing the survey questionnaire. No coercive influence was exerted on respondents to obtain information required for the study. All potential risks such as discomfort, depression, embarrassment, loss of respect, violation of company's protocols, among others were disclosed to respondents and what their participation to the study entailed. The participation to the study was on a voluntary basis and respondents were allowed to withdraw from the research at any time without reprisal.

5.15.2 Right to privacy, confidentiality and protection of data

The privacy, confidentiality and dignity of respondents were protected throughout the study by ensuring that their privacy was not invaded (i.e. meeting a respondent at his/her home) the confidentiality agreement breached. Respondents of the study were not required to disclose their names or any other information that could help identify them. They responded to questions at their convenience and anonymity. Research data were not disclosed to the public or any other unauthorised persons. Only the supervisor, statistician and the researcher had access to the raw data. The statistician was asked to sign a non-disclosure agreement form supplied by UNISA. Information received from respondents was kept safely in a password protected computer and will be destroyed immediately after the research project is complete by deleting the entire file from the computer. The research thesis will be maintained in UNISA's library and will remain its property.

5.15.3 Protection from harm and accountability

Respondents were not exposed to conditions that could affect their psychology (i.e. emotional stress) or their daily routine activities. There were no unforeseen circumstances that arose as a result of the study. The study ensured that respondents did not get adversely affected by the research process by putting in place a communication mechanism (i.e. e-mails or telephone) in which all issues were resolved pacifically without any form of discontent.

5.15.4 Ethical clearance certificate

The researcher ensured that he was familiarised with UNISA's ethics policy as well as the ethical clearance certificate application process. He also ensured that he had obtained the relevant ethical clearance certificate before the commencement of data collection.

5.15.5 Integrity of the thesis

All sources of information such as books, articles, magazines, were acknowledged through referencing. The researcher was truthful, honest and complied with UNISA ethical code of conduct. Data were not fabricated (i.e. increasing the response rate) or appropriated unlawfully to send to a third party. Corrections were not made on respondents' personal information without prior consent.

5.16 CHAPTER SUMMARY

The aim of this chapter was to discuss the research methodology used to investigate the effects of the relationship between GSCMPs, SCDCs and SCP in the South Africa manufacturing sector. The chapter firstly outlined the theoretical orientation of the study and discussed research paradigms. Based on these discussions, it appears that the study adopted the deductive route and was oriented towards the positivism paradigm since it provides suitable scientific tools to objectively measure the cause-and-effect relationships. Moreover, the chapter indicated that the study was quantitative since it aimed to investigate and explain the relationship between research constructs under consideration. It also formulated that the study was correlational and adopted the survey design since it explored the correlational relationship between research variables and used questionnaires as a method of collecting data, respectively. The data were not collected over an extended period since the study was cross-sectional. The chapter further highlighted the importance of the literature review in designing a research project and presenting measurement items that were used to capture the implementation of GSCM in the South African manufacturing sector. It discussed the empirical stance of the study which consisted of sampling design, data collection approach and data analysis as well as the statistical approaches. It revealed that the sample size was 402 respondents across four South African provinces which included, Gauteng, Free State, Mpumalanga and Limpopo. The quota samples were proportionally determined using the relative contribution of each province to the total manufacturing in South Africa. The chapter further stressed that the study used a non-probabilistic purposive sampling design because it was cheap, and respondents were easy to find. It emphasised that purposive sample included judgemental and quota samplings.

Additionally, the chapter indicated that descriptive statistics were ascertained through frequency distribution, standard deviations, mean scores and percentage. It further articulated on the importance and goal of inferential statistics in determining how likely a given statistical result of a sample was representative of the entire population. Inferential statistics also helped to test the parameter estimates through the mean, standard deviations as well as the proportion of the acceptable sample size within South African manufacturers. The chapter elaborated on the procedures to mitigate data related problems and further provided developments on EFA, SEM and CFA since they allowed the researcher to test the theoretical model developed through literature review with given measurement hypotheses. It stressed that the tests were conducted through SPSS version 25.0 and Smart-PLS 3. The relationships between research constructs were determined using SEM. CFA was used to test the accuracy of the measured variables. The chapter ended with ethical considerations by outlining the dispositions undertaken by the study to minimise and reduce risk to research respondents. The next chapter discusses data analysis, presentation and interpretation of results.

CHAPTER 6

DATA ANALYSIS AND INTERPRETATION OF RESULTS

6.1 INTRODUCTION

The objective of this chapter is to present the findings and results of the research project as well as their interpretation. Table 6.1 portrays a comprehensive summary of research activities performed related to data collection and analysis which have been intensively discussed in Chapter 5. This chapter is arranged in six sections of which Section one reports on descriptive analysis and includes, response rate, sample size, position in the company, industry's classification, number of employees, respondents' gender, age group, level of education and work experience. Section two distils respondent perceptions on research constructs and includes green supply chain management practices namely green purchasing, eco-design, green manufacturing, green distribution, reverse logistics, legislation and regulations and green training, supply chain dynamic capabilities and supply chain performance through supply chain agility, supply chain reliability, supply chain costs, supply chain responsiveness, supply chain quality and supply chain balance. The chapter further outlines inferential statistics in Section three through confirmatory factor analysis and model fit analysis. Section four presents the research model assessment and hypotheses testing while Section five provides a comprehensive green supply chain management practices model with hypotheses and Section six ends with a chapter summary.

Table 6.1: Summary of data collection and analysis activities.

Description	Approach and Technique	Comment
Research reasoning	Deductive	It allows to test the cause-and-effect relationships.
Research paradigm	Positivism	It provides analytical tools such as CFA and SEM, to objectively measure the cause-and-effect relationships.

Type of analysis	Quantitative	It requires a structured questionnaire and mainly relies on analysing numerical data.
Time horizon strategy	Cross-sectional	It does not consider what event happens before and after data collection.
Actual sample size	402 respondents	The sample size was pegged at 500 respondents.
Sampling approach	Non-probability	It provides no guarantee that each element of the population will be sampled.
Sampling technique	Purposive and quota	It requires knowledge of SCM.
Geographical focus	Gauteng, Mpumalanga, Free State and Limpopo	Gauteng represents the economic hub, and the rest was selected because of its close proximity to Gauteng.
Type of data collection instrument	Structured online survey questionnaire	It requires respondents to complete the survey on their own.
Data analysis programme	SPSS, Smart-PLS 3 and Microsoft Excel (bundled in Microsoft Office 365)	SPSS was used for data screening, descriptive statistics and EFA while Smart-PLS for evaluation of measurement scale, model fit and hypothesis tests.

Source: Author’s own compilation.

The next section briefly discusses a theoretical aspect of a pilot study in a research survey and then presents the outcome of the pilot study conducted.

6.2 RESULTS OF THE PILOT STUDY

A pilot study is referred to as a preliminary phase of a research project that allows the researcher to identify early potential design related issues (inadequacy of the questionnaire, research approach and technique limitations, research protocols not enabling to answer the research questions and among others) for their possible improvement before embarking on the main study (Gutiérrez *et al.*, 2018; Sternberg, 2019). A pilot study which is a pure reflection of the main study at a small scale does not only help to understand the procedural requirements involved in the main study, but also assists in selecting appropriate methods and techniques that can be beneficial in answering research questions (In, 2017). Moreover, Frey (2018) argues that a pilot study provides substantial information to evaluate the feasibility (modelling the relationship between green supply chain management practices, supply chain dynamic capabilities and supply chain performance) of a research project as well as to detect its potential risks. It is important to point out that the outcome of a pilot test will guide the start of the main study by providing venues for making informed decisions. Some scholars (Eastman, 2017; In, 2017) ascertain that based on the information provided by a pilot study, a researcher can decide which future direction to take: to halt the research project or proceed with the project journey after making relevant amendments on problematic areas of the study. The researcher may also not see the need to consider modifying the research design but rather opt to monitor the research process. Finally, the researcher may decide to proceed without considering any of the modifications to the study design.

Therefore, this section presents and discusses the pilot study results that allowed the researcher to commence his full-scale research project. The aim of the pilot test was to collect preliminary data, evaluate the effectiveness of the questionnaire and make necessary improvements where required. The link to the survey was shared with respondent through WhatsApp and Facebook messengers and email. Respondents were asked to respond to the questionnaire and add comment on the ease of understanding and to identify terms that may cause ambiguity. Comments were made in the appropriate textbox. A total of 50 online questionnaires were distributed from March 15 to March 31, 2021, to supply chain professionals in Gauteng (38), Mpumalanga (7), Free State (4) and Limpopo (1) prior to the commencement of the main study. This quota sampling was based on the relative contributions of manufacturing firms to the South African manufacturing sector presented in Table 5.3 of Chapter 5. The selection criteria were based on the knowledge and experience in supply chain and involvement in supply chain activities. The demographic of respondents did not form part of our area of interest at this stage. The focus was mostly on testing questions related to the implementation of green supply chain management practices, dynamic capabilities and supply chain performance. Out of the 50 questionnaires that were completed and returned, 5 were discarded because of missing data and only 45 were processed since they were complete and valid. Table 6.2 shows the results of the pilot test analysis.

Table 6.2: Pilots test results displaying the values of Cronbach's alpha of each construct.

Measurement scale	Sample number	Mean	Standard deviation	Average item-total correlation	Number of items	Number of items deleted	Cronbach alpha
GP	45	3.730	0.502	0.575	6	0	0.800
ED	45	3.860	0.321	0.411	6	0	0.625
GM	45	3.934	0.765	0.714	5	0	0.876
GD	45	3.896	0.405	0.661	6	0	0.841
RL	45	4.085	0.399	0.577	6	0	0.796
LR	45	2.851	0.486	0.338	6	0	0.605
GT	45	3.814	0.481	0.655	5	0	0.845
SCDC	45	4.054	0.375	0.675	5	0	0.856
SCA	45	3.880	0.375	0.441	5	0	0.668
SCREL	45	3.928	0.499	0.815	5	0	0.923
SCC	45	3.974	0.419	0.732	5	0	0.889
SCR	45	3.851	0.523	0.568	6	0	0.805
SCQ	45	4.063	0.396	0.394	6	0	0.667
SCB	45	3.906	0.289	0.397	6	0	0.702

Abbreviations: **GP** = Green Purchasing; **ED** = Eco design; **GM** = Green Manufacturing; **GD** = Green Distribution; **RL** = Reverse Logistics; **LR** = Legislation and Regulations; **GT** = Green Training; **SCDC** = Supply chain dynamic capabilities;

SCA = Supply chain agility; **SCREL** = Supply chain reliability; **SCC** = Supply chain costs; **SCR** = Supply chain responsiveness; **SCQ** = Supply chain quality; **SCB** = Supply chain balance.

Source: Pilot test analysis results (2021).

A glance at Table 6.2 indicates that the recommended scores for the measurement scales were archived. It can be noticed that most measurement scales had a Cronbach's alpha reliability ≥ to 0.70 except for ED, LR, SCA and SCQ that carried alpha reliability scores below 0.70. It is important to point out that opinions differ in literature regarding the acceptable alpha value for Cronbach's alpha reliability. Some scholars recommend an ideal alpha value of 0.60 (Daud *et al.*, 2018; EL Hajjar, 2018; Ozsahin & Derya, 2022) while others suggest a minimum value of 0.70 for a new scale (Hair *et al*., 2017). No measurement items (ED, LR, SCA and SCQ) were deleted since their scores were consistent with Daud *et al.* (2018) and EL Hajjar (2018) who suggest that a score of 0.60 is sufficient to determine that a scale has a good internal consistency reliability. Further in Table 6.2, the corrected item-total correlations have values above the cut-off value of 0.3 as recommended by Daud *et al.* (2018); EL Hajjar, 2018; Seydi *et al.* (2021) and Ozsahin and Derya (2022). This indicates that questions were correlated and were discriminating well. Therefore, the measurement instrument was deemed to be meeting the reliability requirements since it exhibited adequate internal consistency. It was found suitable for assessing the implementation of GSCM practices in the South African manufacturing sector.

The next section discusses descriptive statistics from the main study.

6.3 DESCRIPTIVE STATISTICS

Descriptive statistics can be described as a set of statistical techniques used by a researcher to describe, summarise and organise the collected data (Breslin, 2020; Ruel, 2021). Organising data greatly simplifies and helps to understand its underlying structure, its usefulness and highlights potential patterns within the data set (Ruel, 2021). The descriptive analysis in the study is simply shown in form of absolute frequencies (simple or actual counts) and relative frequencies (percentages). It is broken down into the response rate, sample size, the profile of companies and the demographic characteristics of respondents.

6.3.1 Response rate

Response rate plays an important role in survey research as its improvement in terms of high level of participation provides greater accuracy and representativeness of the target sample (Garner, as cited by Allen, 2018). It is also relevant to point out that a sample is considered accurate, credible and representative at its selected size since a nonresponse reduces its effective size. However, in practice this is not always the case especially if too many people chose not to complete the survey for whatever reasons. In other words, as a response rate increases, it is perceived that it considers multiple views, hence improving the target sample accuracy and reducing the likelihood of nonresponse bias (Fielding *et al.*, 2017). In line with this statement, Stoop (2020) asserts that a high response rate is perceived as an illustration of a good and accurate survey research. Response rate can be described as a ratio of individuals who respond to a survey by the total number of people who might possibly respond (Fielding *et al.*, 2017; Garner, as cited by Allen, 2018; Stoop, 2020). Similarly, Krishnamurty, as cited by Frey (2018) and Ruel (2021) define a response rate as a percentage of the selected sample that completes the survey or those who have agreed to participate in the survey divided by the sample size. Agustini (2018:156) considers response rate as a proportion of those who completed the survey by the eligible participants.

One can argue that there is no unique and universally accepted protocol to compute a response rate in survey research. This has been demonstrated by The American Association of Public Opinion Research (AAPOR). It recognises six different methods of computing response rates which take into account completed interviews or questionnaires, partially completed interviews or questionnaires, nonresponses and unknown (other) where the research is not certain of the eligibility of respondents (Krishnamurty, as cited by Frey, 2018). The study considers factors that include the completed (valid) questionnaires and the number of questionnaires distributed to calculate the response rate and it is illustrated through Equation 6.1.

$$Response\ rate\ (in\ \%) = \left(\frac{Total\ number\ of\ valid\ responses\ returned}{Total\ number\ of\ questionnaires\ distributed}\right) x\ 100.$$ **[Equation 6.1]**

$$Overall\ Response\ rate = (402/500)\ x\ 100 = 80.40\%$$

Table 6.3: Response rate parameters and calculation.

Description	Overall counts	Provincial counts			
		Gauteng	Mpumalanga	Free State	Limpopo
Total number of questionnaires sent	500	381	67	38	14
Total number of questionnaires returned	419	301	66	38	14
Total number of questionnaires not returned	81	80	01	0	0
Total number of unusable questionnaires	17	16	01	0	0
Total number of valid questionnaires	402	285	65	38	14
Calculated overall response rate	**80.40%**	**74.8%**	**97%**	**100%**	**100%**

Source: Author's own compilation.

As presented in Table 6.3, a total of 500 structured survey questionnaires (this number is exclusive of the sample selected for the pilot study) were distributed to respondents across Gauteng, Mpumalanga, Free State and Limpopo partitioned into 381; 67; 38; and 14 respectively. From 500 questionnaires that were sent, 419 were completed and returned which included 301 from Gauteng, 66 from Mpumalanga, 38 from Free State and 14 from Limpopo. In overall 402 questionnaires (Gauteng 285; Mpumalanga, 65; Free State, 38; and Limpopo, 14) were successfully completed and deemed valid for analysis while 17 (1 for Mpumalanga and 16 for Gauteng) were discarded due to errors, thus making an overall response rate of 80.40%. Provincial response rates for Gauteng, Mpumalanga, Free State and Limpopo stood at 74.8%, 97%, 100% and 100% respectively. Out of the 500 questionnaires, only 81 were not returned split up into one (1) for Mpumalanga and 80 for Gauteng.

Studies by Fincham (2008) and Meterko *et al.* (2015) recommend 60% as the minimum acceptable criterion for response rate in surveys. Another study by Frey (2018) reveals that a minimum acceptable response rate of 80% is considered appropriate and representative of a sample and those failing to meet this level usually require some complex nonresponse analytical techniques to determine the level of nonresponse bias. Ruel (2021) on the other hand postulates that a sample that achieves a minimum response rate of 70% is acceptable and deemed accurate and representative of the sample. Given the fact that there is no real consensus on the minimum acceptable response rate percentage, it can be suggested that the current study meets the minimum requirements set by these various authors.

6.3.2 Final sample size

A cross-sectional survey was administered using Microsoft forms to measure the implementation of GSCM and test its relationships with DCs and SCP. The study involved collecting data from four provinces in the South African manufacturing sector namely Gauteng, Mpumalanga, Free State and Limpopo. A survey questionnaire link was sent to 500 respondents across the four provinces of interest. Respondents were given a two-week window period to complete the survey questionnaires and return them to the researcher. A reminder was sent numerous times to respondents who did not respond within the specified period. Data were collected between April 2021 and November 2021 and a total of 402 responses were received. The presentation starts with the analysis of the information from positions held by respondents in their respective companies with reference to frequencies and percentages.

6.3.3 Position in the company

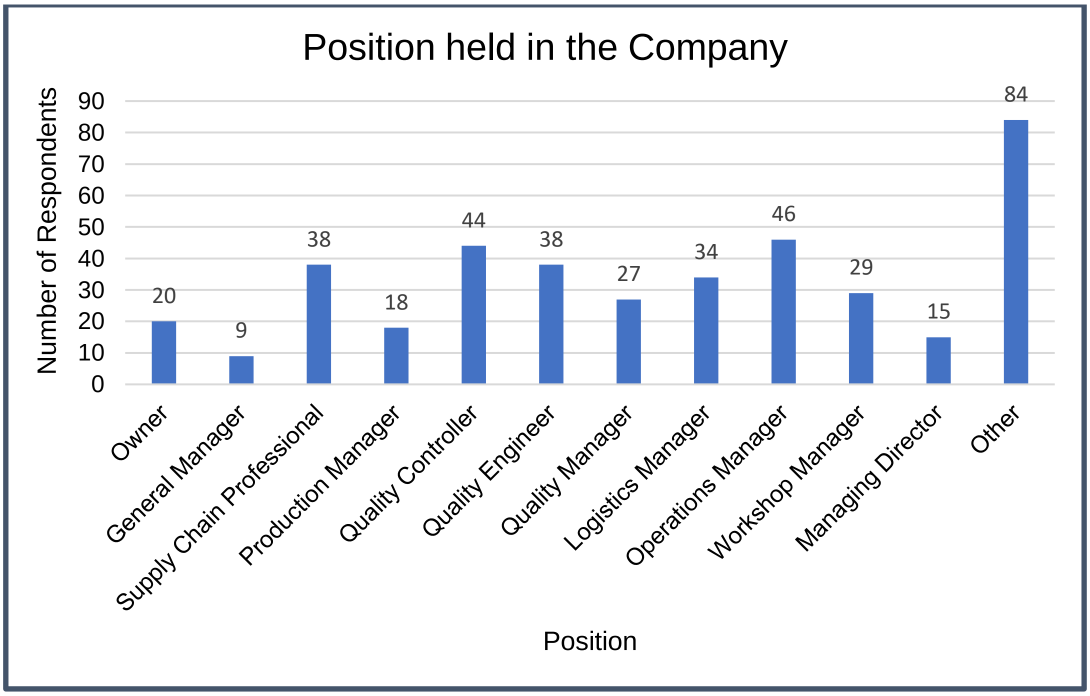
The frequencies and percentages pertaining to the type of position held by respondents in their respective companies are illustrated in Table 6.4. In addition, Figure 6.1 provides a visual format from information contained in Table 6.4 by depicting the relationship between the number of respondents and their positions, with the results of the descriptive analysis discussed below.

Table 6.4: Frequencies and percentages of the type of position in the company

Position in the company			
Variable	**Category**	**Frequency (n)**	**Percent**
Position in the company	Owner	20	5.0
	General Manager	9	2.2
	Supply Chain Professional	38	9.5
	Production Manager	18	4.5
	Quality Controller	44	10.9
	Quality Engineer	38	9.5
	Quality Manager	27	6.7
	Logistics Manager	34	8.5
	Operations Manager	46	11.4
	Workshop Manager	29	7.2
	Manager Director	15	3.7
	Other	84	20.9
	Total	**402**	**100.0**

Source: Descriptive analysis results (2021)

Figure 6.1: Position held in the company.



Source: Author's own compilation based on the survey data.

Table 6.4 and Figure 6.1 clearly outline that the category "other" was the most dominant position with 20.9% (n=84). It represented positions not listed in the study. The category "other" included positions such as warehouse supervisors, storemen, procurement managers, project managers, procurement specialists, supply and demand planners, inventory controllers, distribution managers, export specialists, production clerk and among others. Figure 6.1 also indicates that the category “other” is followed by operations manager with11.4% (n=46), then quality controller 10.9% (n=44), quality engineer and supply chain professional come toe-to-toe with 9.5% (n=38) each and the least represented were respondents holding the position of general manager with 2.2% (n=9).

6.3.4 Industry’s classification

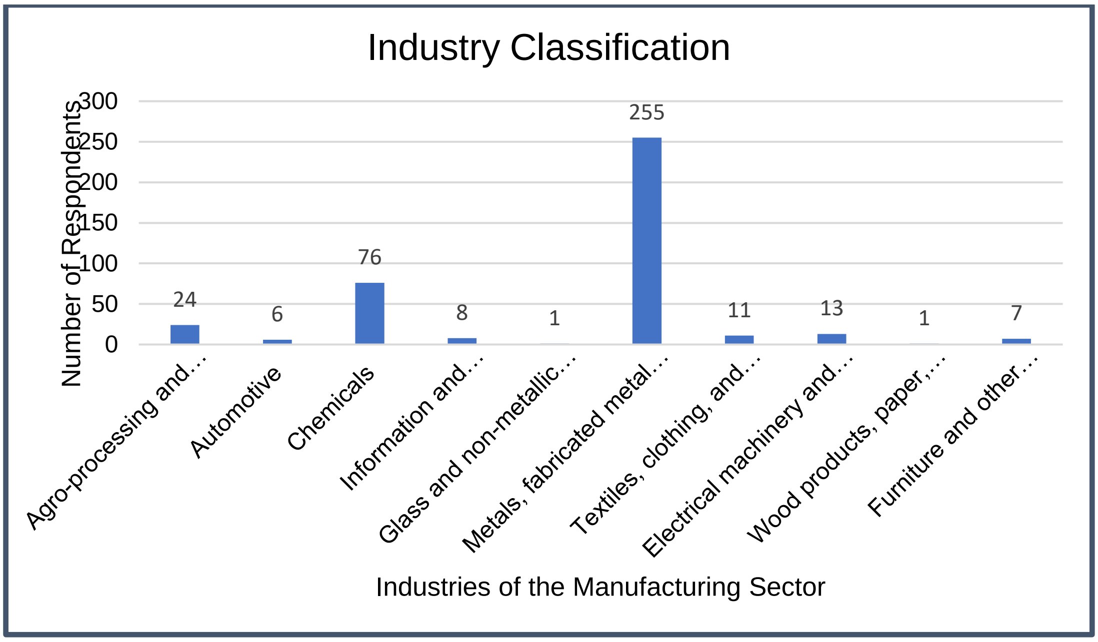
Information on the industry’s classification is presented below with reference to frequencies and percentages. Figure 6.2 which derives from Table 6.5 data, shows the repartition of the South African manufacturing sector. The results are discussed below Table 6.5.

Table 6.5: Industry’s classification

Industry			
Variable	**Category**	**Frequency (n)**	**Percent**
Industry’s classification	Agro-processing and tobacco	24	6.0
	Automotive	6	1.5
	Chemicals	76	18.9
	Information and communications technology	8	2.0
	Glass and non-metallic mineral products	1	.2
	Metals, fabricated metal products, machinery and equipment	255	63.4
	Textiles, clothing and footwear	11	2.7
	Electrical machinery and apparatus	13	3.2
	Wood products, paper and printing	1	.2
	Furniture and other manufacturing	7	1.7
	Total	**402**	**100.0**

Source: Descriptive analysis results (2021).

Figure 6.2 Industry's classification



Source: Author's own compilation based on the survey data.

Figure 6.2 displays various industries that form part of the manufacturing sector in South Africa. Table 6.5 and Figure 6.2 show that the Metals, fabricated metal products, machinery and equipment industry was mostly represented with more than half of the total respondents 63.4% (n=255), followed by the chemicals industry with 18.9% (n=76), the Agro-processing and tobacco industry stands at 6.0% (n=24) and the least represented were Glass and non-metallic mineral products and Wood products, paper and printing industries with 0.1% (n=1) respondent each.

6.3.5 Repartition of respondents by province

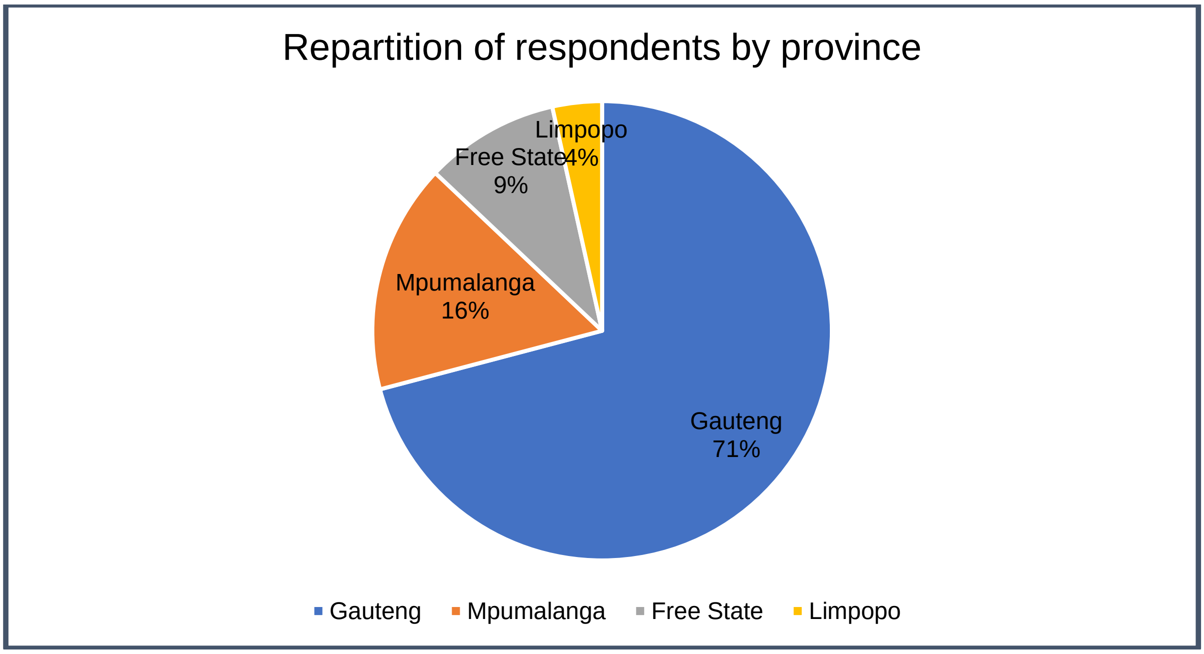
The repartition of respondents by province is presented below with reference to frequencies and percentages. Table 6.6 and Figure 6.3 outline the proportion of respondents in the four provinces respectively.

Table 6.6: Repartition of respondents by province

Province			
Variable	**Category**	**Frequency**	**Percent**
Repartition of respondents by province	Gauteng	285	70.9
	Mpumalanga	65	16.2
	Free State	38	9.5
	Limpopo	14	3.5
	Total	**402**	**100.0**

Source: Descriptive analysis results (2021).

Figure 6.3 Repartition of respondents by province



Source: Author's own compilation based on the survey data (2021).

Figure 6.3 shows that the province with the largest proportion of respondents compared to other three provinces was Gauteng with 71% (n=285), followed by Mpumalanga with 16% (n=65), Free State 9.5% (n=38) and Limpopo 3.5% (n=14).

6.3.6 Number of employees

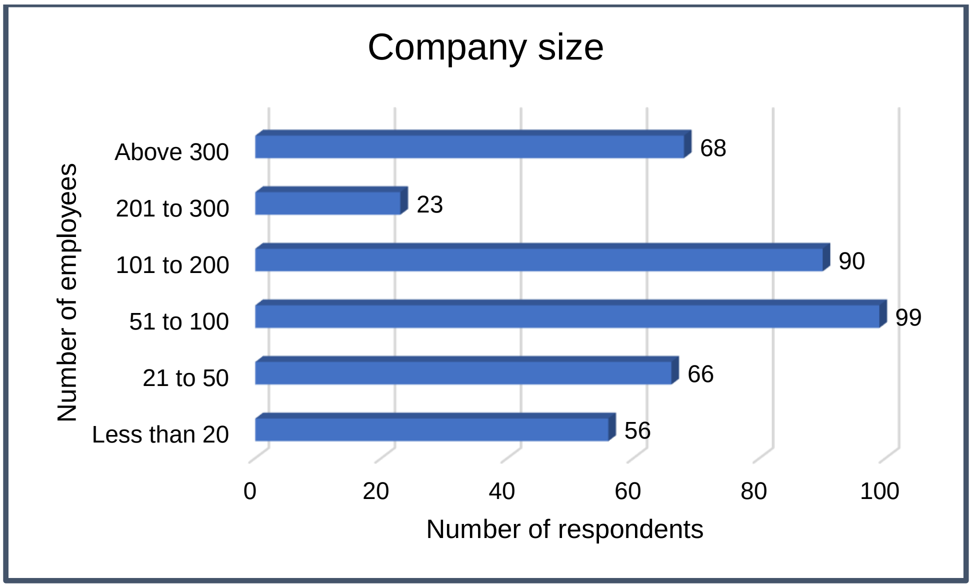
The number of employees is presented in Table 6.7 with reference to frequencies and percentages and the results in Figure 6.4.

Table 6.7: Number of employees

No of Employees			
Variable	**Category**	**Frequency (n)**	**Percent**
Number of employees	Less than 20	56	13.9
	21 to 50	66	16.4
	51 to 100	99	24.6
	101 to 200	90	22.4
	201 to 300	23	5.7
	Above 300	68	16.9
	Total	**402**	**100.0**

Source: Descriptive analysis results imported from SPSS (2021).

Figure 6.4: Chart representing the size of the company



Source: Author's own compilation based on the survey data

Figure 6.4 portrays proportions of the survey response rates from multiple companies of difference sizes. It appears that companies with 51-100 employees were mostly represented with 24.6% (n=99), followed by companies with 101 to 200 workers 22.4% (n=90), then companies above 300 employees 16.9% (n=68). The least represented were companies having a workforce between 201 and 300 with 5.7% (n=23).

6.3.7 Working experience

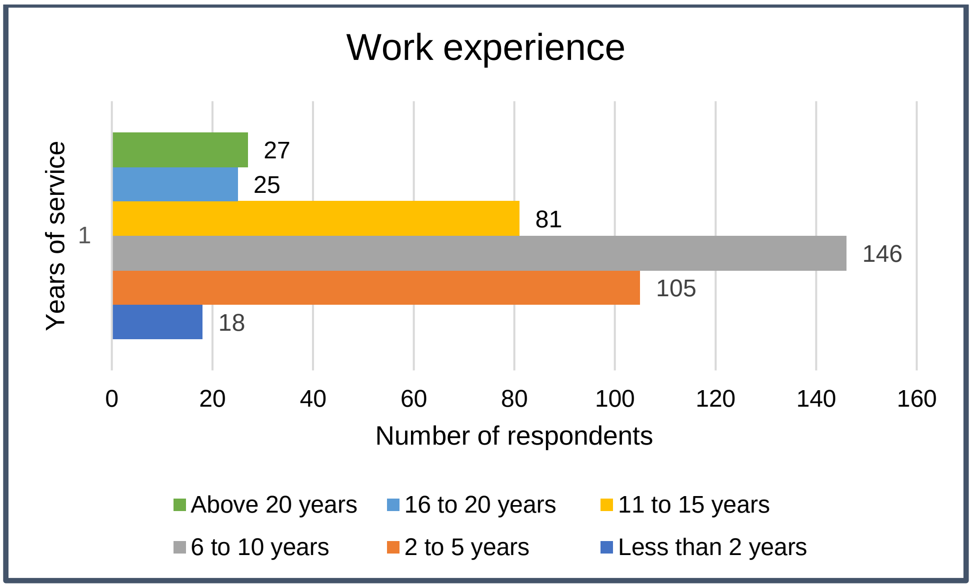
Table 6.8 and Figure 6.5 show respondent's working experience with reference to frequencies and percentages.

Table 6.8: Work experience

Experience			
Variable	**Category**	**Frequency (n)**	**Percent**
Working experience	Less than 2 years	18	4.5
	2 to 5 years	105	26.1
	6 to 10 years	146	36.3
	11 to 15 years	81	20.1
	16 to 20 years	25	6.2
	Above 20 years	27	6.7
	Total	**402**	**100.0**

Source: Descriptive analysis results imported from SPSS (2021).

Figure 6.5: Chart representing years of service



Source: Author's own compilation based on the survey data (2021).

Figure 6.5 shows the relative proportions of respondents in relation to their working experiences. Respondents with 6 to 10 years of work experience made up about 1/3 of the total respondents 36.3% (n=146), while respondents with 2-to-5-year experience made up 26.1% (n=105). The remaining proportions which included less than 2 years, 11 to 15 years, 16 to 20 years and above 20 years of experience in a company represented 4.5% (n=18), 20.1% (n=81), 6.2% (n=25) and 6.7% (n=27) respectively.

6.3.8 Respondents' gender

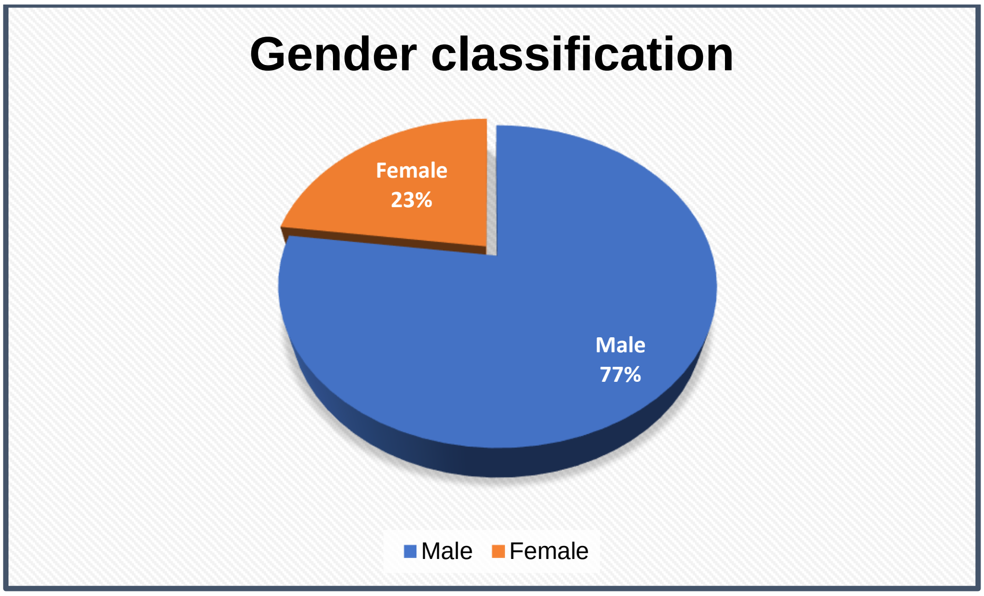
The frequencies and percentages pertaining to respondents' gender are illustrated in Table 6.9 and Figure 6.6.

Table 6.9: Gender of respondents

Gender			
Variable	**Category**	**Frequency**	**Percent**
Respondents' gender	Male	310	77.1
	Female	92	22.9
	Total	**402**	**100.0**

Source: Descriptive analysis results imported from SPSS (2021).

Figure 6.6: Chart representing respondents' gender



Source: Author's own compilation based on survey data.

Table 6.9 and Figure 6.6 show that 77% (n=310) of respondents were males, whereas females represented only 23% (n=92).

6.3.9 Age group

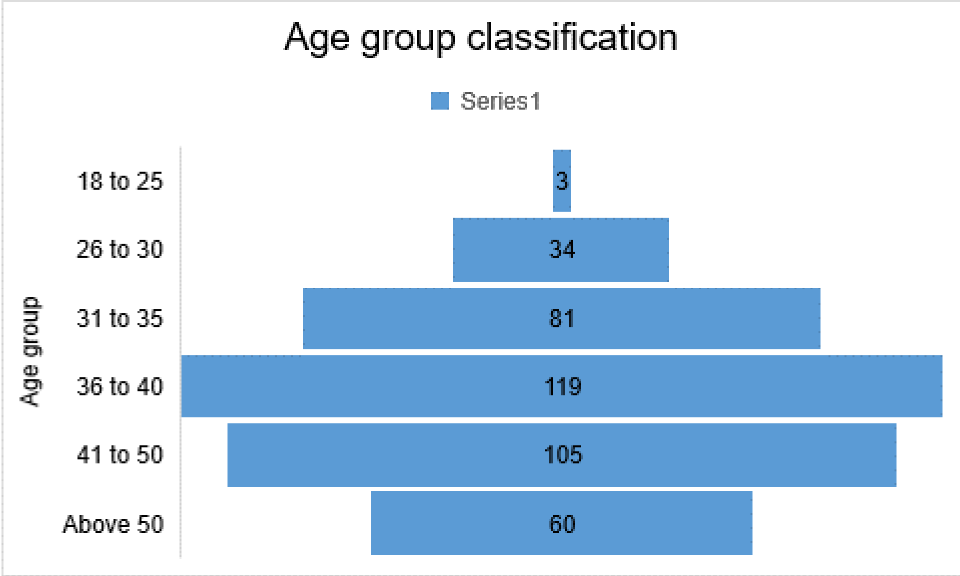
Table 6.10 and Figure 6.7 below present group proportions of respondents by age in terms of the frequencies and percentages.

Table 6.10: Group age of respondents

Age			
Variable	**Category**	**Frequency**	**Percent**
Age group	18 to 25	3	.7
	26 to 30	34	8.5
	31 to 35	81	20.1
	36 to 40	119	29.6
	41 to 50	105	26.1
	Above 50	60	14.9
	Total	**402**	**100.0**

Source: Descriptive analysis results imported from SPSS (2021).

Figure 6.7 Chart representing the group age of respondents.



Source: Author's own compilation based on the survey data (2021).

Table 6.10 and Figure 6.7 indicate that the group aged (36-40) constituted 29.6% (n=119) of respondents, the group aged (41-50) represented 26.1% (n=105), the group aged (31-35) constituted 20.1% (n=81) while individuals above 50 represented 14.9% (n=60). The rest which included two groups aged between (18 -25) and (26-30) made up small representations with 0.7% (n=3) and 8.5% (n=34) respectively.

6.3.10 Level of education

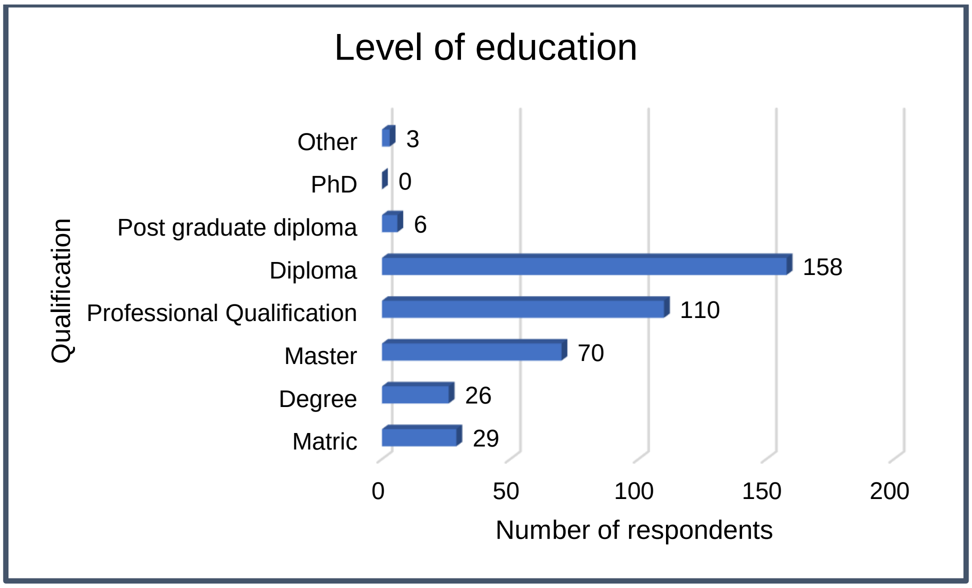
Table 6.11 and Figure 6.8 supply information about the education statistics of respondents with reference to frequencies and percentages.

Table 6.11: Level of education of respondents

Education			
Variable	**Category**	**Frequency**	**Percent**
Level of education	Matric	29	7.2
	Degree	26	6.5
	Master	70	17.4
	Professional Qualification	110	27.4
	Diploma	158	39.3
	Post graduate diploma	6	1.5
	Other	3	.7
	Total	**402**	**100.0**

Source: Descriptive analysis results imported from SPSS (2021).

Figure 6.8: Chart representing the level of education of respondents



Source: Author's own compilation based on the survey data (2021).

Table 6.11 and Figure 6.8 portray that more than 1/3 (39.3% with n=158) of total individuals who participated in the survey held diplomas, 27.4% (n=110) held professional qualifications, while 17.4% (n=70) of respondents had Masters. People with Matric certificates constituted 7.2% (n=29), respondents with degrees represented 6.5% (n=26) and other accounted to only 0.7% (n=3).

6.3.11 Race of respondents

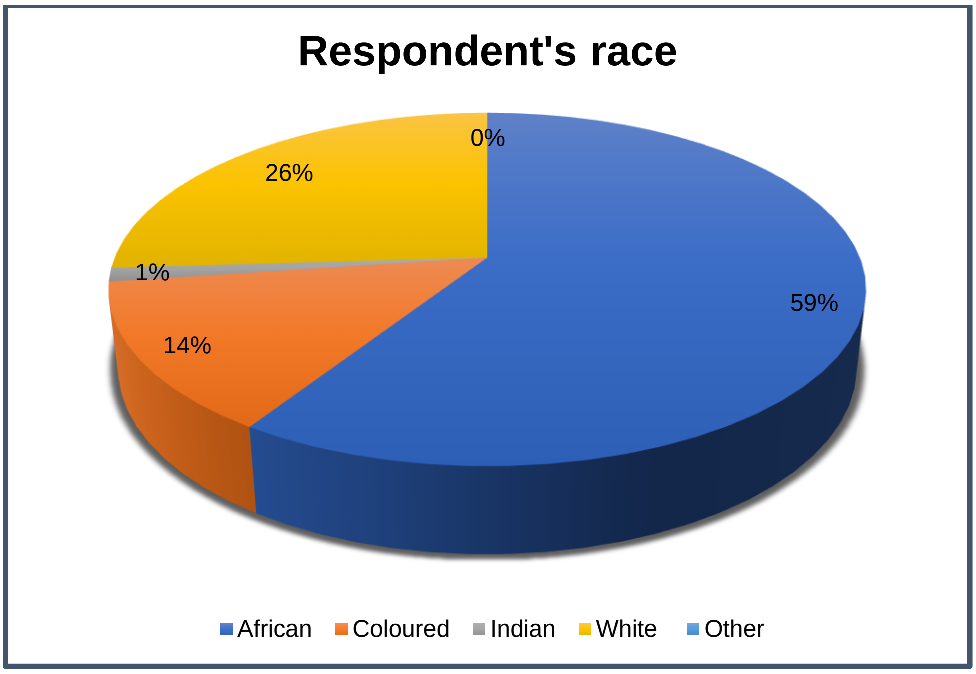
Table 6.12 and Figure 6.9 show respondents' demography of the South African manufacturing sector by ethnic groups.

Table 6.12: Race of respondents

Race			
Variable	**Category**	**Frequency**	**Percent**
Respondent's race	African	237	59.0
	Coloured	55	13.7
	Indian	5	1.2
	White	105	26.1
	Total	**402**	**100.0**

Source: Descriptive analysis results imported from SPSS (2021)

Figure 6.9: Chart representing respondent's race



Source: Author's own compilation based on the survey data (2021).

As shown in Table 6.12 and Figure 6.9, the most highly represented group in the sample were Africans (59%; n=237). This was followed by whites (26%; n=105), coloured (14%; n=55) and Indians were the least represented with (1%; n=5).

The next section discusses the results of exploratory factor analysis.

6.4 EXPLORATORY FACTOR ANALYSIS

As indicated in Section 5.12.5, EFA was applied in the study to test for scale dimensionality. The analysis explored the actual correlation between items and trimmed away items that did correlate to reduce statistical errors as well as formed new and unexpected factors. In doing so, six indicators were used.

i. Bartlett's test of sphericity – a significant p-value < 0.05 was desirable.
ii. Kaiser Meyer Olkin (KMO) – estimates greater than 0.50 were considered high quality scores indicating sample size adequacy.
iii. Factor loadings – Factors loadings that generated a minimum loading of 0.50 were retained.
iv. Communalities – variables with high communalities were desirable and those with low communalities (less than 0.3) were eliminated.
v. Eigenvalue – The Kaiser rule required retaining factors with eigenvalues greater than 1.0.

vi. Cattell's scree – This exercise visually identified the breakpoint at which the scree begins and retained only factors that do not belong to the scree.

It is important to note that during the process of scale purification, only 1 item (GD1) was discarded because it had a low communality of 0.298. The results of EFA are presented in Tables, 6.13, 6.14 and 6.15 respectively.

The subsections below present the results of the EFA for GSCM practices, SCDCs and SCP.

6.4.1 Exploratory factor analysis for green supply chain management practices

The results of the EFA for GSCM practices are presented in Table 6.13.

Table 6.13: Exploratory factor analysis for green supply chain management practices

Construct	Items	Communalities	Factor loadings		KMO Sampling adequacy	Bartlett's Test of Sphericity	Eigenvalue	Percentage variance explained
			1	2				
Green Purchasing (GP)	GP1 GP2 GP3 GP4 GP5	0.412 0.674 0.533 0.673 0.620	0.642 0.821 0.730 0.820 0.787	-	0.777	X^2=739.221 df=10 p=0.000	2.911 0.892 0.491 0.395 0.311	58.227%
Eco-design (ED)	ED1 ED2 ED3 ED4 ED5	0.731 0.733 0.766 0.755 0.662	0.855 0.856 0.875 0.869 0.814	-	0.858	X^2=1285.260 df=10 p=0.000	3.647 0.490 0.364 0.284 0.216	72.941%
Green Manufacturing (GM)	GM1 GM2 GM3 GM4 GM5	0.586 0.662 0.539 0.725 0.508	0.765 0.813 0.734 0.851 0.713	-	0.838	X^2=732.642 df=10 p=0.000	3.019 0.686 0.536 0.406 0.353	60.377%
Green Distribution (GD)	GD2 GD3 GD4 GD5 GD6	0.611 0.442 0.728 0.742 0.769	0.782 0.665 0.853 0.862 0.877	-	0.836	X^2=1019.131 df=10 p=0.000	3.293 0.683 0.477 0.326 0.222	65.855%
Reverse Logistics (RL)	RL2 RL3 RL4	0.854 0.883 0.770	0.854 0.855 0.822	-0.352 -0.389 -0.307	0.809	X^2=1286.534 df=15 p=0.000	1.077 0.502 0.473	76.220%
** Product Returns (PR)	PR1 PR5 PR6	0.628 0.699 0.739	0.758 0.641 0.637	0.230 0.537 0.578			3.529 0.303 0.149	58.814%
Legislation and Regulation (LR)	LR1 LR2 LR4	0.652 0.834 0.773	0.808 0.913 0.879	-	0.680	X^2=519.524 df=3 p=0.000	2.259 0.501 0.241	75.291%
Green training (GT)	GT1 GT2 GT3 GT4 GT5	0.726 0.826 0.845 0.820 0.708	0.852 0.909 0.919 0.906 0.842	-	0.867	X2=1696.147 df=10 p=0.000	3.925 0.451 0.282 0.202 0.141	78.494%

** Product returns= new factor extracted from Reverse Logistics

Source: Author's own compilation based on the survey data.

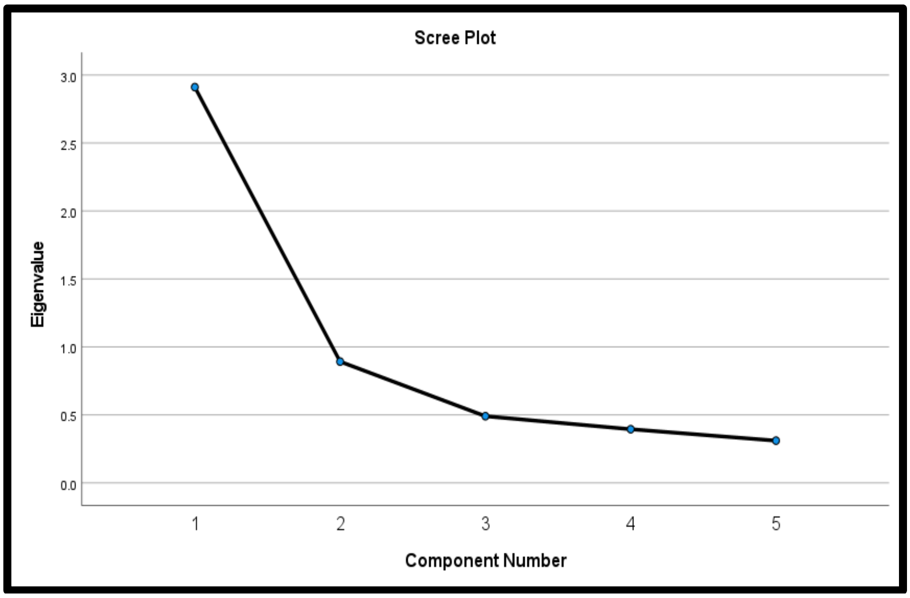
The section below focusses on two statistical analyses (KMO and Bartlett's tests) from Table 6.13 required to check for the suitability of the collected data through factorability prior performing EFA. It can be seen that the Bartlett's test values of all measurement scales used in the study are statistically significant (correlated) with p-values equal to 0.000 which is < to 0.005 as recommended by scholars (i.e. Dawson, 2018) while the KMO scores are all above 0.50 (ranging from 0.680 to 0.867) indicating that variables used could be grouped into a small set of underlying factors, hence suitable for carrying out component analysis.

The rest of the methods or tests presented in Table 6.13 are discussed below.

6.4.1.1 Exploratory factor analysis results for green purchasing

Table 6.13 shows that green purchasing (GP) is unidimensional since only one factor was extracted from the analysis. The construct consisted of 5 items (GP1-GP5) all of which have displayed higher scores of communalities (minimum of 0.412 and a maximum of 0.674). The factor loadings showed a strong association (0.642 to 0.821) between items while only one item produced an eigenvalue of 2.911 which is greater than the cuff-off score of 1.0. The extracted factor accounted to 58.227% of the total variance explained. Moreover, the Cattell's scree demonstrated that only one factor above the scree was retained as shown Figure 6.10. This is an indication that the items of GP literally measured what they were intended to.

Figure 6.10: Scree plot for green purchasing



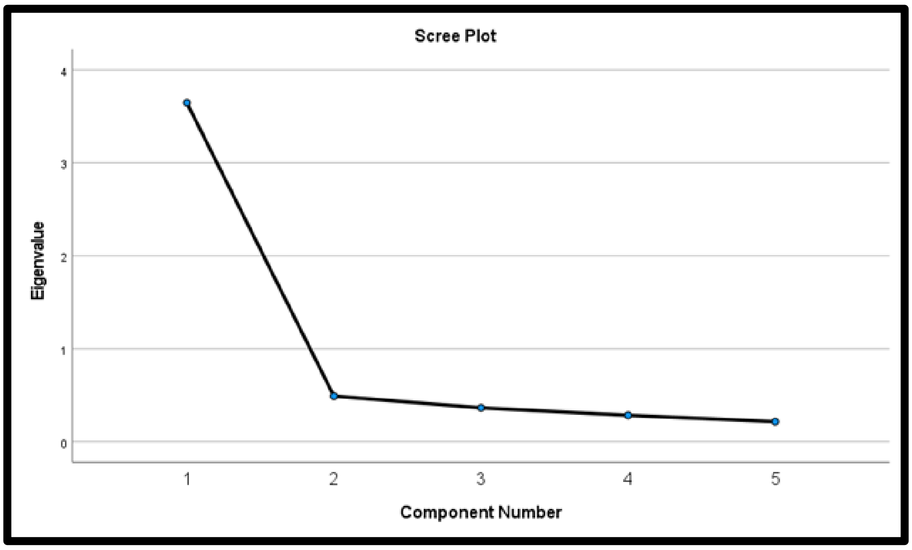
Source: Graph imported from SPSS (2021).

Figure 6.10 shows eigenvalues generated from the reduced correlation matrix. Only one factor precedes the drop in the graph and this factor has been retained since it meets the Kaiser's rule requirement (eigenvalue ≥.1.0).

6.4.1.2 Exploratory factor analysis results for Eco-design

Table 6.13 shows that only one factor was extracted from ED scale. The variable was composed of 5 items (ED1-ED5) and the extracted factor accounted for 72.941% of the total variance explained. The items generated high levels of communalities ranging between 0.662 and 0.766 which are greater than the cut-off score of 0.30. Loading scores are all acceptable since they are above 0.50 (they range from a minimum of 0.814 to a maximum of 0.875). This is an indication of a strong relationship between items and the component. Table 6.13 also presents an eigenvalue of 3.647 which is far greater than 1.0 and consequently was retained since it represented the underlying factor in the component. The Cattell's scree also confirmed that the factor that was retained factor had an eigenvalue above the scree as depicted in Figure 6.11. This demonstrates the items of ED measured what they were intended to.

Figure 6.11: Scree plot for Eco-design



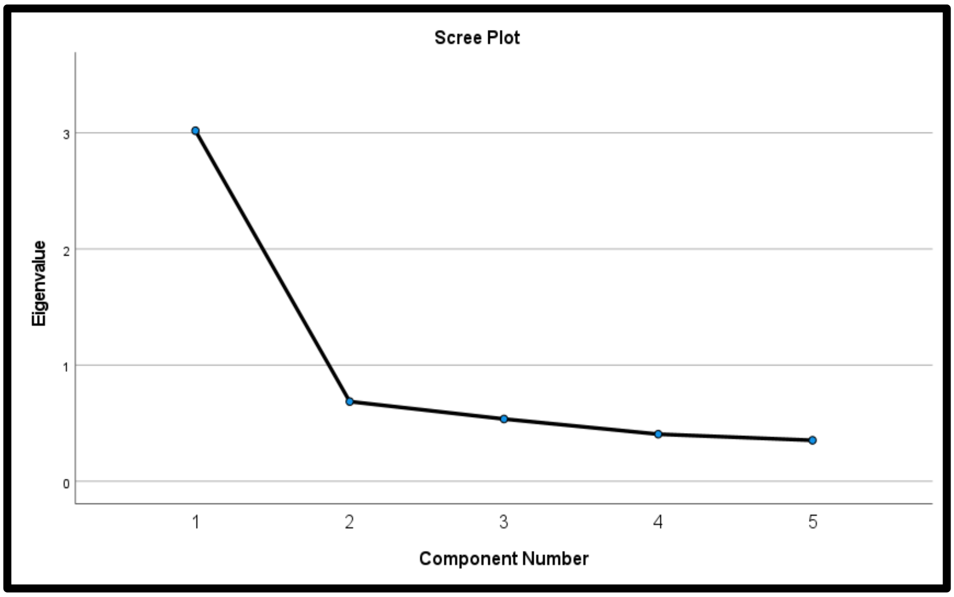
Source: Graph imported from SPSS (2021).

The graph in Figure 6.11 shows eigenvalues plotted against the number of items. The point before the drop represents the extracted factor and the flat line represents the scree and suggests that there are little eigenvalue changes between each successive factor.

6.4.1.3 Exploratory factor analysis results for green manufacturing

This factor consisted of 5 items namely GM1, GM2, GM3, GM4 and GM5 respectively. One factor was extracted from the analysis and had an eigenvalue of 3.019 accounting for much variance as a single variable (60.377% of the total variance explained for green manufacturing predictor scale). Communalities range from 0.508 to 0.725 which are greater than 0.30. The factor loadings (0.713 to 0.851) indicate that items correlated meaningfully with the component. The Cattell's scree was also used to confirm that the retained factor had an eigenvalue that was above the scree as depicted in Figure 6.12.

Figure 6.12: Scree plot for green manufacturing



Source: Graph imported from SPSS (2021).

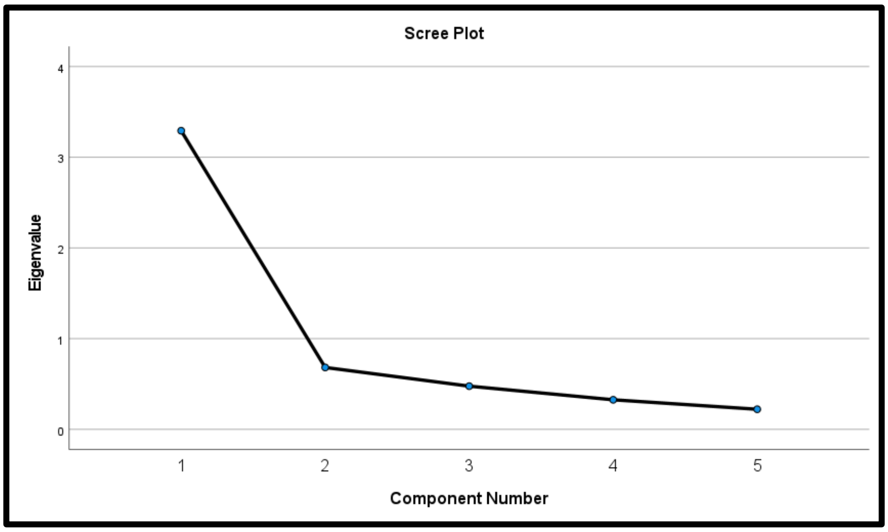
The scree plot in Figure 6.12 indicates that there is one component above the cut-off value of 1.0. The rest of the components which includes 2, 3, 4 and 5 have very low rate of changes as we move progressively forward. That is the reason the curve seems flat at the scree level.

6.4.1.4 Exploratory factor analysis results for green distribution

This factor consisted of six items (GD1 to GD6) of which one (GD1) was discarded during the process of purification from the scale since it had a low level of communality

(0.298 < 0.30). GD2 to GD 6 were considered because their communalities range from 0.442 to 0.769 which are greater than the minimum of 0.3. The factor loadings range from 0.665 to 0.877 depicting values far beyond the minimum recommended score of 0.5. Only one factor was extracted and retained from the analysis since it had an eigenvalue of 3.293 greater which is greater than 1.0. This factor accounted for 65.855% of the total variance explained.

Figure 6.13: Scree plot for green distribution



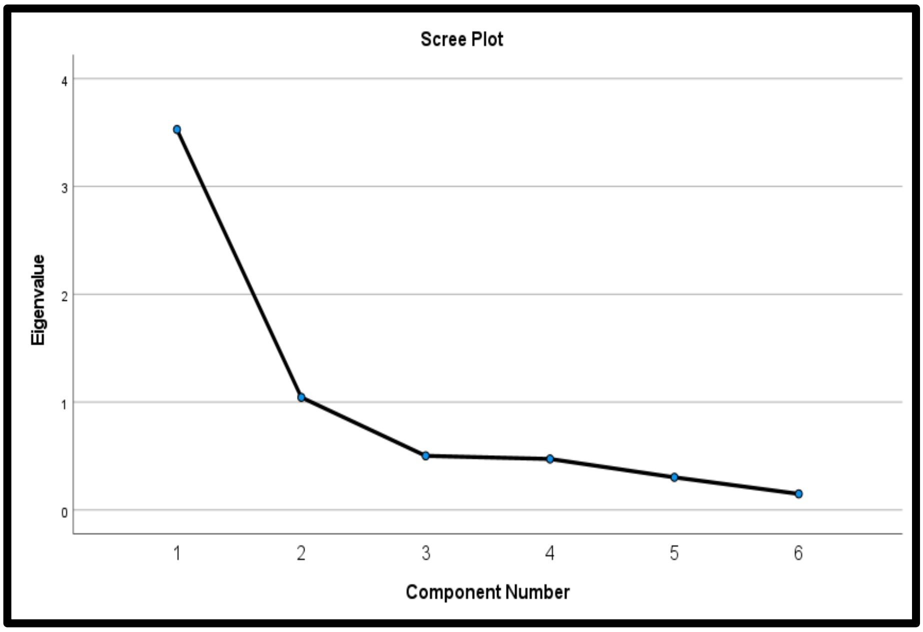
Source: Graph imported from SPSS (2021).

The scree plot in Figure 6.13 also demonstrates that only one factor was retained as a result of having an eigenvalue above 1.0.

6.4.1.5 Exploratory factor analysis results for Reverse logistics

The EFA of RL shows that two factors were extracted of which “Factor 1” accounted for 58.814% and “Factor 2” for 76.220% of the total variance explained. The first extracted factor retained the name of RL (RL2; RL3 and RL4) while the second extracted factor was labelled product returns (PR) and was composed of items 1;5 and 6 (PR1; PR5 and PR6) of the RL scale. The measured scores of variances of each item shared among other items indicate acceptable levels with scores ranging from 0.628 to 0.883 (communality ≥ 0.3). The loadings of these two factors are also acceptable with scores ranging from 0.637 to 0.855. The extracted factors had eigenvalues of 3.529 and 1.077 respectively. These eigenvalues are plotted in Figure 6.14.

Figure 6.14: Scree plot for reverse logistics and product returns



Source: Graph imported from SPSS (2021).

The graph in Figure 6.14 demonstrates that there are two eigenvalues that precede the last drop of the curve. Thereafter, the nearly linear line indicates that there is very little changes in eigenvalue scores.

The section below shows the varimax rotation analysis performed post principal component analysis.

Table 6.14: Two-Factor Rotated Solution for reverse logistics

Item	**Component**	
	1	**2**
RL1	0.466	**0.641**
RL2	**0.894**	0.235
RL3	**0.917**	0.206
RL4	**0.841**	0.252
RL5	0.187	**0.815**
RL6	0.159	**0.845**
Eigenvalues	3.529	1.077
Percentage of variance Explained	58.814%	76.220%

Source: Author's own compilation based on the survey data.

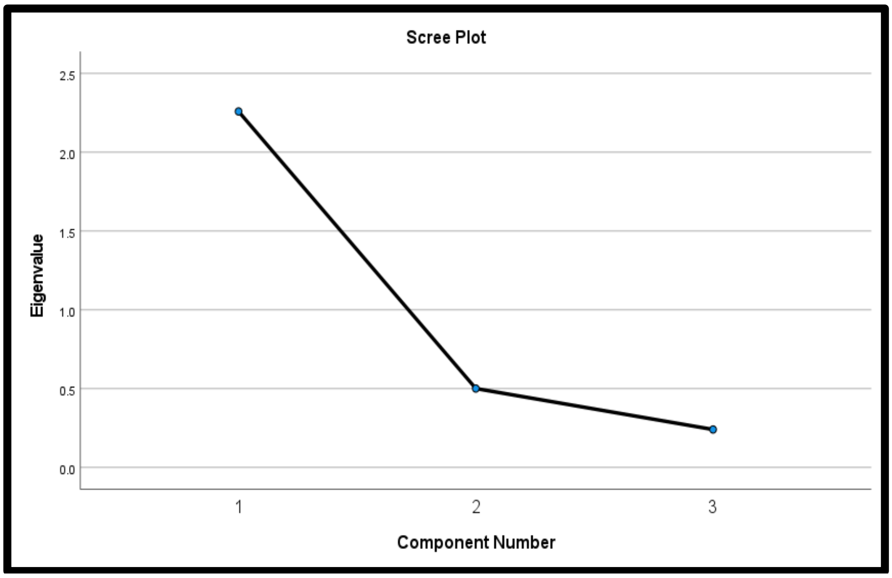
The varimax rotation results in Table 6.14 bring a clarification to the relationship among factors. It can be seen that items RL1 and RL2 do not load on component 1 since the weight of RL1 is much lower than that of RL2. RL1 and RL2 do not load on component 2. In order to determine whether a factor loads, its score must be greater than 0.50. It then appears that the variables that load very well on component 1 comprise RL2, RL3 and RL4 (this factor has retained the name of Reverse Logistics) while the factors that load on component 2 include RL1, RL5 and RL6 (this factor was labelled product returns).

The new factor that was created by the study has been named product returns (PR). PR can be characterised as a process of returning products to a retailer or a manufacturer because of their end-of-use, end-of-life, repair, or warranty conditions (Shaharudin *et al.*, (2018) considers product returns as past sales or remanufactured auto-parts that have been returned to manufacturers by customers for rebate. It is relevant to point out that a product returns strategy is of a great importance for manufacturers since it contributes to the firm's economic, environmental and social sustainability through reductions in raw materials use (Shaharudin *et al.*, 2017; Shaharudin *et al*., 2019).

6.4.1.6 Exploratory factor analysis results for Legislation and regulations

The factor LR scale was composed of three items (LR1, LR2 and LR4) all of which generated communalities of 0.652; 0.834 and 0.773 respectively. Only one component was extracted and retained with an eigenvalue of 2.259. This factor accounted for 75.291% of the total variance explained. The extracted factor had an eigenvalue of 2.259 which greater than the cuff-off score of 1 (see Figure 6.15).

Figure 6.15: Scree plot for legislation and regulations.



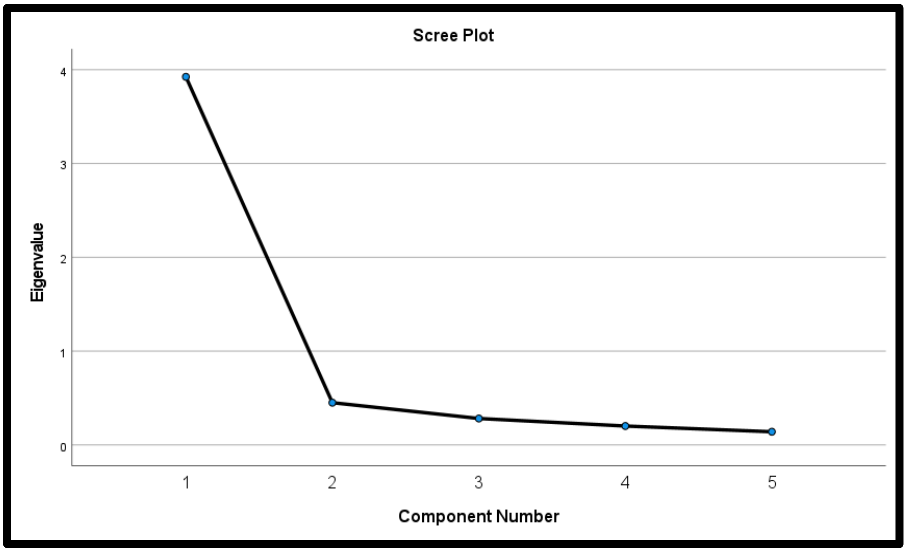
Source: Graph imported from SPSS (2021).

The scree plot indicates that only one factor was extracted since it had an eigenvalue greater than 1.0.

6.4.1.7 Exploratory factor analysis results for green training

As indicated in Table 6.13, GT consists of GT1 to GT5. The variable generated high levels of communalities ranging from 0.708 to 0.845. Only one factor was extracted from the EFA with an eigenvalue of 3.925. The loadings were acceptable and ranged from 0.842 to 0.919 which is far greater than the recommended score of 0.5. The scree plot in Figure 6.16 also shows the single factor that was extracted.

Figure 6.16: Scree plot for green training.



Source: Graph imported from SPSS (2021).

The scree plot demonstrates that there is only one eigenvalue that precede the last drop of the curve.

6.4.2 Exploratory factor analysis for supply chain dynamic capabilities

The results of EFA for SCDC are presented in Table 6.15.

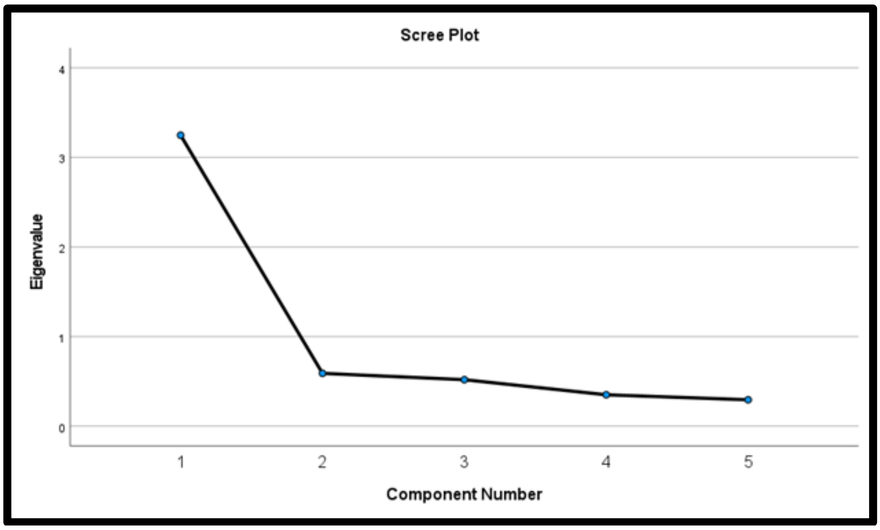
Table 6.15: Exploratory Factor Analysis for Supply chain dynamic capabilities

Construct	Items	Communalities	Factor loadings	KMO Sampling adequacy	Bartlett's Test of Sphericity	Eigenvalue	Percentage variance explained
Supply chain Dynamic capabilities (DC)	SCDC1 SCDC2 SCDC3 SCDC4 SCDC5	0.649 0.687 0.572 0.752 0.589	0.806 0.829 0.756 0.867 0.768	0.844	X^2=909.227 df=10 p=0.000	3.248 0.589 0.518 0.350 0.294	64.965%

Source: Author's own compilation based on the survey data.

Table 6.15 portrays the data from the EFA for SCDC. It can be observed that the Bartlett's test value of measurement scales is statistically significant with a p-value equals to 0.000 which is < 0.005 while the KMO score stands at 0.844 which above the cut-off score of 0.5 hence, indicating a sample adequacy. SCDC consists of 5 items namely SCDC1 to SCDC5. SCDC generated high levels of communalities ranging from 0.572 to 0.752. One factor was extracted from the analysis and had an eigenvalue of 3.248. This factor accounts for much of the variance as a single variable (64.965% of the total variance explained for SCDC predictors scale). The factor loadings range from 0.756 to 0.867 which indicates that items correlated meaningfully with the component. The Cattell's scree was also used to confirm the retained factor had one component that was above the scree as depicted in Figure 6.17.

Figure 6.17: Scree plot for supply chain dynamic capabilities.



Source: Graph imported from SPSS (2021).

Figure 6.17 shows the plotting of eigenvalues of each individual principal component. At the peak of the curve is the factor that accounts for much of the variability generating an eigenvalue of 3.248.

6.4.3 Exploratory factor analysis for supply chain performance

The results of EFA for SCP are presented in Table 6.16.

Table 6.16: Exploratory Factor Analysis for Supply chain performance.

Construct	Items	Communalities	Factor loadings		KMO Sampling adequacy	Bartlett's Test of Sphericity	Eigenvalue	Percentage variance explained
			1	2				
Supply Chain Agility (SCA)	SCA1 SCA2 SCA3 SCA4 SCA5	0.561 0.554 0.558 0.586 0.588	0.749 0.745 0.747 0.765 0.767	-	0.732	X^2=736.94 4 df=10 p=0.000	2.847 0.931 0.528 0.435 0.258	56.949%
Supply Chain Reliability (SCREL)	SCREL1 SCREL2 SCREL3 SCREL4 SCREL5	0.665 0.655 0.707 0.680 0.691	0.816 0.809 0.841 0.825 0.832	-	0.838	X^2=1051.5 63 df=10 p=0.000	3.399 0.616 0.395 0.322 0.268	67.977%
Supply Chain Costs (SCC)	SCC1 SCC2 SCC3 SCC4 SCC5	0.679 0.846 0.789 0.812 0.769	0.824 0.920 0.888 0.901 0.877	-	0.888	X2=1589. 760 df=10 p=0.000	3.895 0.413 0.296 0.215 0.181	77.901%
* Customer Satisfaction (CS)	CS1 CS2 CS3	0.813 0.837 0.783	0.785 0.812 0.831	-0.444 -0.421 -0.303	0.819	X^2=1187.3 58 df=15 p=0.000	3.478 1.124 0.483	57.967% 76.704%
Supply Chain Responsiveness (SCR)	SCR4 SCR5 SCR6	0.731 0.755 0.683	0.623 0.728 0.769	0.585 0.474 0.302			0.376 0.305 0.234	
Supply Chain Quality (SCQ)	SCQ3 SCQ5 SCQ6	0.742 0.828 0.853	0.861 0.910 0.924	-	0.722	X^2=676.54 9 df=3 p=0.000	2.423 0.374 0.202	80.772%

Supply Chain Balance (SCB)	SCB1 SCB2 SCB3 SCB4 SCB5 SCB6	0.535 0.533 0.510 0.381 0.615 0.471	0.732 0.730 0.714 0.617 0.785 0.687	-	0.783	X^2=722.713 df=15 p=0.000	3.046 0.927 0.683 0.557 0.450 0.337	50.766%
***** Customer Satisfaction= new factor extracted from SCR								

Source: Author's own compilation based on the survey data.

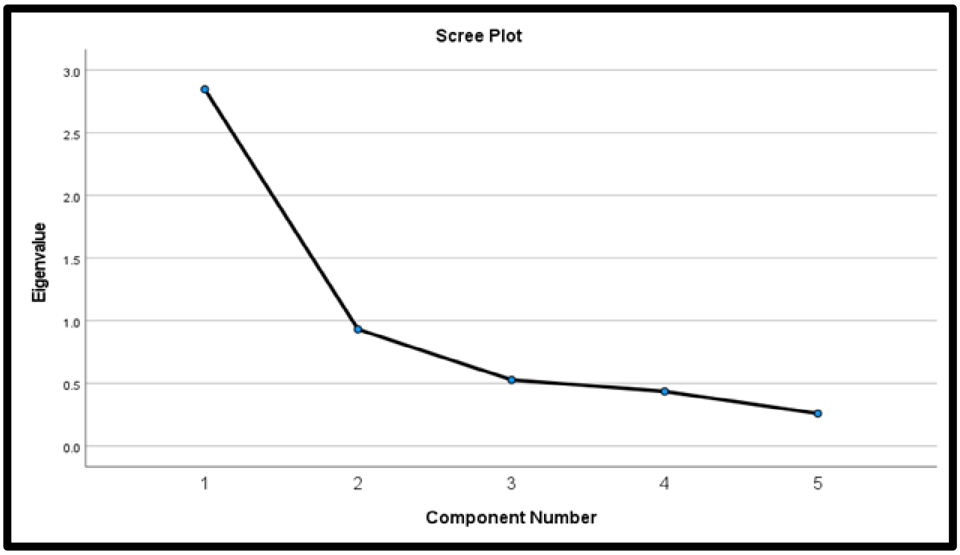
As presented in Table 6.16, the KMO of all scales used to measure the SCP are above 0.5 ranging from 0.722 to 0.888. The Bartlett's Test of Sphericity values are significant with p-values of 0.000 which are inferior to the recommended score of 0.005. This result supports the adequacy of the sample to perform EFA.

The rest of the test results is presented and discussed below.

6.4.3.1 Supply chain agility

In Table 6.16, it appears that SCA which is composed of five items (SCA1 to SCA5) has high levels of communality scores ranging from 0.554 to 0.0.588 which are greater than 0.50. Only one factor was extracted from the analysis with factor loadings between 0.745 and 0.767. This factor account for much of the percentage of variance explained with 56.949%. The loadings are superior to 0.50 hence, suggesting a strong relationship between the items and the component. The retained component produced an eigenvalue of 2.847 which is greater than 1.0 representing the underline factor. This result is also confirmed in the scree plot presented in Figure 6.18.

Figure 6.18: Scree plot for supply chain agility.



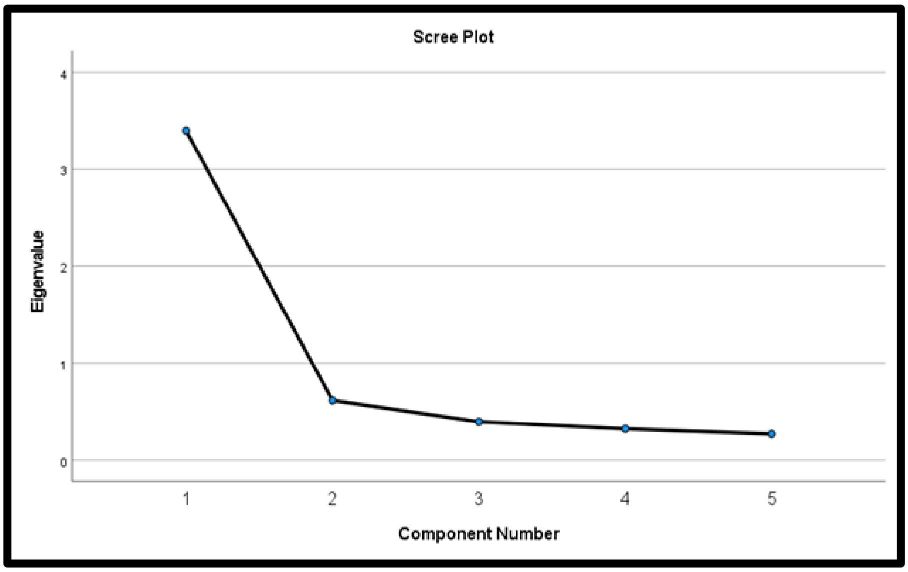
Source: Graph imported from SPSS (2021).

Figure 6.18 clearly shows that one factor is demarcated from the others with an eigenvalue of 2.847 above the scree.

6.4.3.2 Supply chain reliability

SCREL comprises five items namely SCREL1, SCREL2, SCREL3, SCREL4 and SCREL 5. The items all show high levels of communalities (0.655 to 0.707) with values above 0.50. One factor was extracted in this analysis with an eigenvalue of 3.399 accounting for 67.977% of the total variance explained. The loadings scores are between 0.809 to 0.841 highlighting a strong relationship between items and the component. The extracted factor is displayed in Figure 6.19.

Figure 6.19: Scree plot for supply chain reliability



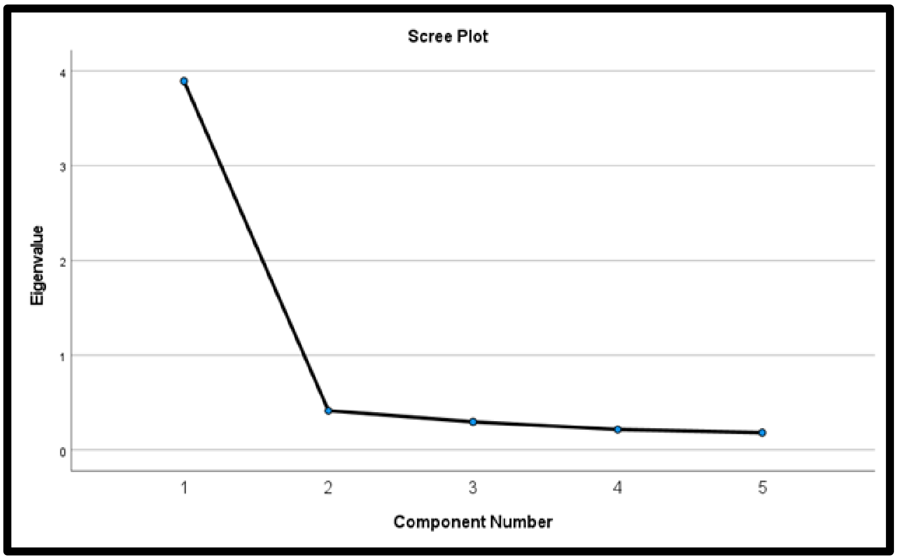
Source: Graph imported from SPSS (2021).

The graph in Figure 6.19 shows that only one factor was extracted and retained. This factor has a quality score of 3.399.

6.4.3.3 Supply chain costs

The EFA of SCC portrays communality scores between 0.679 and 0.846. SCC is composed of 5 items (SCC1 to SCC5). The loading values stand between 0.824 and 0.920 inclusive while only one factor was extracted and retained. This retained factor has an eigenvalue of 3.895 which is greater than the recommended score of 1.0. The factor represents much of the variance as it accounts for 77.901%. Figure 6.20 shows the retained factor at the peak of the graph.

Figure 6.20: Scree plot for supply chain costs



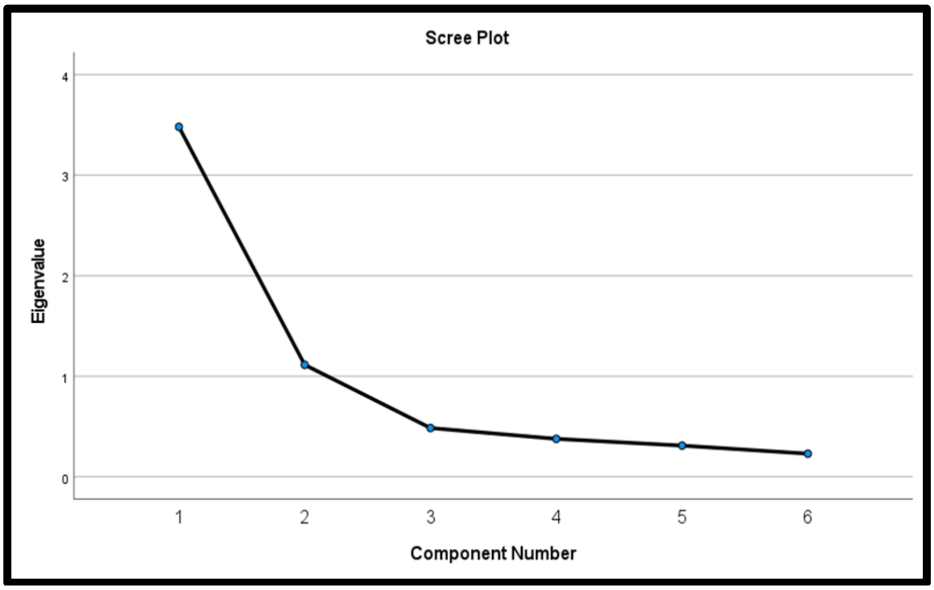
Source: Graph imported from SPSS (2021).

Figure 6.20 clearly shows the line plotting eigenvalues of the principal component analysis. It is seen that only one factor was retained with an eigenvalue of 3.895 which represent the single factor above the scree.

6.4.3.4 Supply chain responsiveness

The EFA of SCR shows that two factors were extracted of which Factor 1 accounts for 57.967% and Factor 2 for 76.704% of the total variance explained. The first factor retained the name of SCR and is composed of 3 items (SCR4, SCR5 and SCR6) while the second factor was labelled Customer Satisfaction (CS) and comprises 3 items (CS1, CS2 and CS3). The measured scores of variances of each item shared among other items indicate acceptable levels with scores ranging from 0.683 to 0.837 (communality ≥ 0.3). The loadings produced acceptable scores of 0.623 to 0.769 and 0.785 to 0.831 respectively. The retained factors have eigenvalue scores of 3.478 and 1.124 respectively. The graph in Figure 6.21 portrays the retained factor.

Figure 6.21 Scree plot for supply chain responsiveness and customer satisfaction.



Source: Graph imported from SPSS (2021).

The graph in Figure 6.21 plots eigenvalues generated from the EFA. The two extracted factors (CS and SCR) are above the scree with quality scores ≥ 1.0 suggesting that they account for much of the variance.

Table 6.17 below shows the varimax rotation analysis performed post principal component analysis.

Table 6.17: Two-Factor Rotated Solution for supply chain responsiveness.

Item	Component	
	1	2
SCR1	**0.885**	0.172
SCR2	**0.891**	0.207
SCR3	**0.829**	0.309
SCR4	0.094	**0.850**
SCR5	0.246	**0.834**
SCR6	0.389	**0.729**
Eigenvalues	3.478	1.124
Percentage of variance Explained	57.967%	76.704%

Source: Author's own compilation based on the survey data.

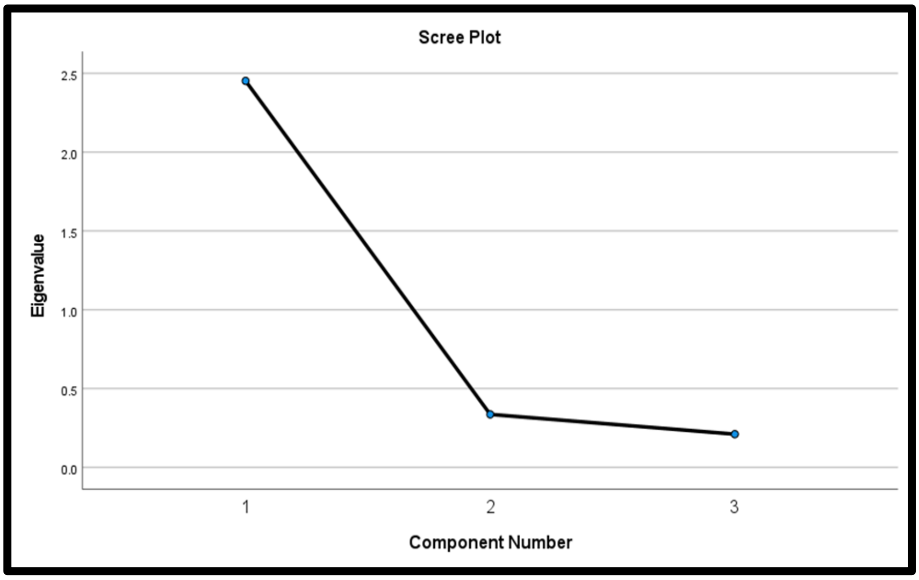
The varimax rotation results in Table 6.17 clarifies the association between factors. It can be seen that items SCR1 and SCR2 load very well (loading greater than 0.50) on component 1 as their scores are relatively close. The same factors do not load on component 2 since the weight of SCR1 is much lower than that of SCR2. The variables that load very well on component 1 comprise SCR1, SCR2 and SCR3 (this factor was named customer satisfaction) and those that load well on component 2 include SCR4, SCR5 and SCR6 (this factor retained the label of supply chain responsiveness). Based on this assessment, it can clearly be suggested that SCR1, SCR2 and SCR3 are associated with component 1 and SCR4, SCR5 and SCR6 with component 2.

The new factor that was created by the study has been named customer satisfaction (CS). CS can be defined as an effective tool to maintain a long-term relationship between a firm and its customers (Gupta & Pandey, 2021). Udofia *et al.* (2020) describe CS as an emotional connection that is established between a customer and a manufacturer as a result of a satisfactory experience for its offerings. CS plays an important role in organisations as it helps to increase customer loyalty which yields higher revenues and bigger market shares (Parmata & Chetla, 2020; Udofia *et al*., 2020). For instance, Miao *et al.* (2021) postulate that a customer who has a positive experience about a product will be motivated to repurchase it. Therefore, organisations must continuously strive to achieve customer satisfaction since it can also help to attract new customers, hence providing a competitive advantage.

6.4.3.5 Supply chain quality

SCQ is composed of 3 items (SCQ3, SCQ 5 and SCQ6). The analysis shows that only one factor was extracted with an eigenvalue of 2.423. This factor accounts for 80.772% of the total variance explained. The loading scores are between 0.861 and 0.924 while the communalities generated higher values from 0.742 to 0.853. Figure 6.22 portrays the scree plot for SCQ.

Figure 6.22: Scree plot for supply chain quality



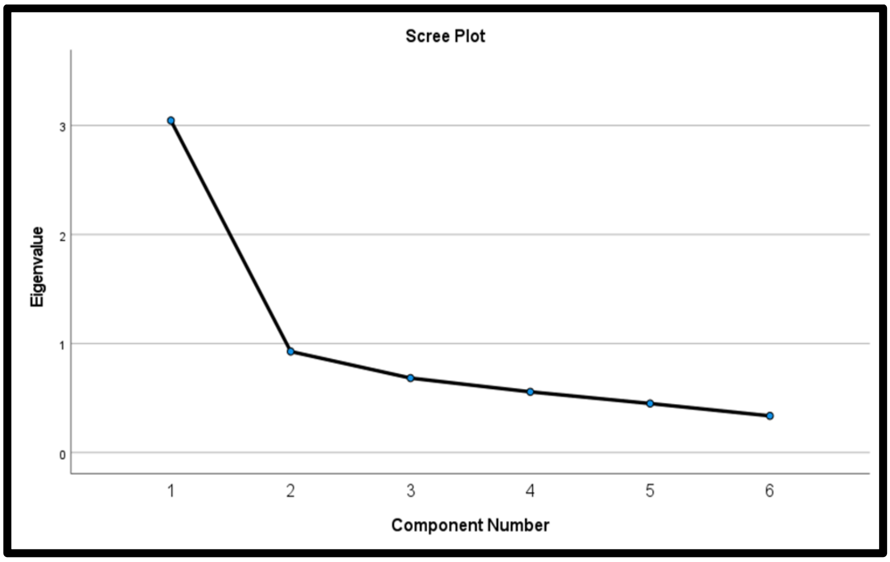
Source: Graph imported from SPSS (2021).

The graph in Figure 6.22 shows the retained factor with an eigenvalue of 2.423 which is at the peak of the curve.

6.4.3.6 Supply chain balance

The EFA results of SCB which is composed of SCB1 to SCB6 show high levels of communalities of all items (communalities > 0.30). Loadings have acceptable scores ranging from 0.687 to 0.785. Only one factor was extracted and has an eigenvalue of 3.046 as presented in Figure 6.23. This factor accounts for 50.766% of the total variance explained.

Figure 6.23: Scree plot for supply chain balance



Source: Graph imported from SPSS (2021).

Figure 6.23 shows that only one factor is extracted and retained with eigenvalue equal or greater than 1.0.

6.4.4 Summary of the Results of the exploratory factor analysis

Table 6.18 shows the results after data purification process performed through the EFA.

Table 6.18: Data purification process (exploratory factor analysis)

Scale	Items discarded	Scale in factor analysis
Green Purchasing	None	Unidimensional
Eco-design	None	Unidimensional
Green Manufacturing	None	Unidimensional
Green Distribution	GD1	Unidimensional
Reverse Logistics	None	2 factors extracted (RL & PR)
Legislation and Regulations	None	Unidimensional
Green Training	None	Unidimensional
Supply Chain Dynamic Capabilities	None	Unidimensional
Supply Chain Agility	None	Unidimensional
Supply Chain Reliability	None	Unidimensional
Supply Chain Costs	None	Unidimensional
Supply Chain Responsiveness	None	2 factors extracted (CS & SCR)
Supply Chain Quality	None	Unidimensional
Supply Chain Balance	None	Unidimensional

Source: Author's own compilation based on the survey data.

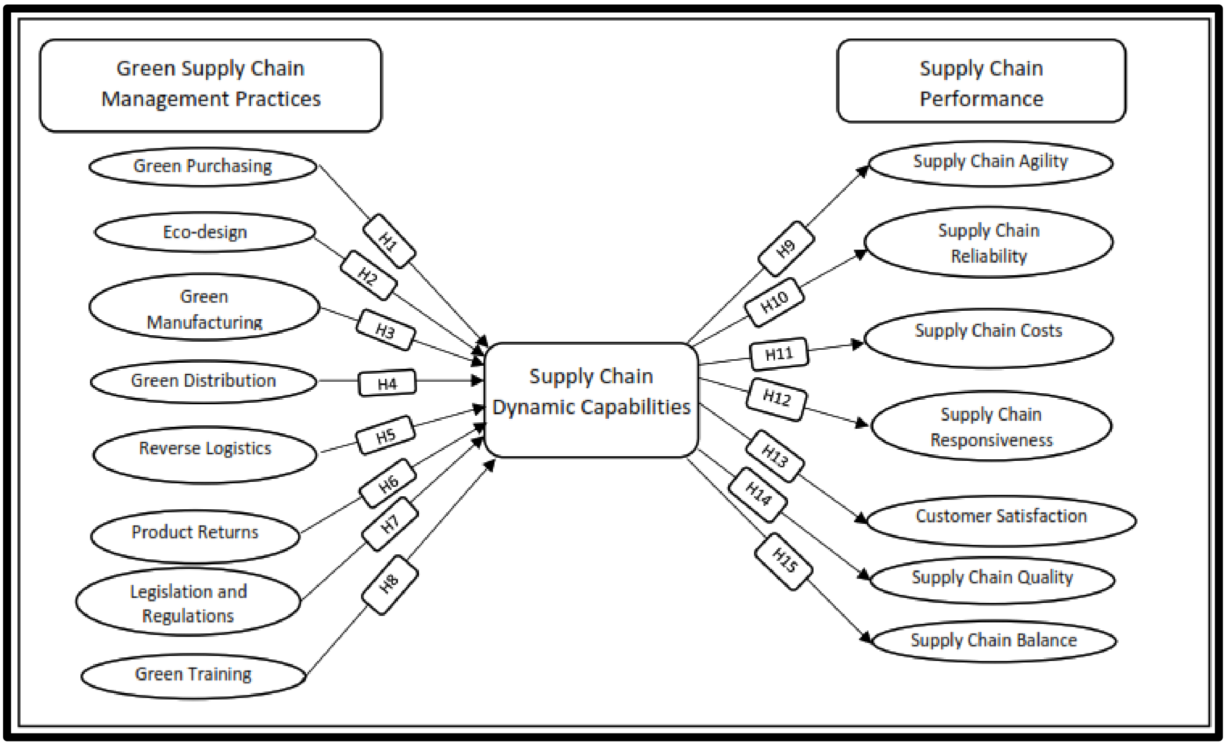
Table 6.18 portrays the results of the purification process. It appears that most of the variables were unidimensional in exception of RL and SCR. From the RL scale, two factors were extracted of which one retained the name RL and included 3 items (RL2; RL3 and RL4) while the other was labelled product returns (PR) composed of PR1; PR5 and PR6. Furthermore, two factors were also extracted from the SCR scale; the first factor retained the name SCR composed of 3 items (SCR4, SCR5 and SCR6) and the second factor was labelled Customer Satisfaction (CS) comprised 3 items (CS1, CS2 and CS3). The purification process discarded one item (GD1) from the GD scale due to its low level of communality (0.298 < 3).

The next section discusses the revised conceptual framework based on the EFA whereby two new factors were extracted.

6.4.5 Revised conceptual framework based on exploratory factor analysis.

A new factor was extracted in the EFA of GSCM practices within the Reverse Logistics scale. As a result, the new factor was labelled Product Returns (PR) and included three items (RL1, RL5 and RL6) while the three other items which comprised RL2, RL3 and RL3 retained the label reverse logistics. The analysis of the SCP scale also generated two factors. The new factor which included SCR1, SCR2 and SCR3 was named Customer Satisfaction (CS) while SCR4, SCR5 and SCR6 retained the label supply chain responsiveness (SCP). Based on this outcome, the initial conceptual framework was revised and replaced by that in Figure 6.24, which incorporates the additional factors.

Figure 6.24 Revised conceptual framework based on exploratory factor analysis.



Source: Author's own compilation based on exploratory factor analysis (2022).

Figure 6.24 shows changes incorporated into the revised conceptual framework. Consequently, hypotheses of the study were also revised to include new ones and to illustrate the relationships between variables. The revised hypotheses are as follows:

H_1: Green purchasing (GP) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the manufacturing sector in South Africa.

H_2: Eco-design (ED) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the manufacturing sector in South Africa.

H_3: Green manufacturing (GM) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_4: Green distribution (GD) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_5: Reverse logistics (RL) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_6: Product returns (PR) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_7: Legislation and regulations (LR) exert a significant positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_8: Green training (GT) exerts a significant positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.

H_9: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain agility (SCA) in the South African manufacturing sector.

H_{10}: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain reliability (SCREL) in the South African manufacturing sector.

H_{11}: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain costs (SCCs) in the South African manufacturing sector.

H_{12}: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain responsiveness (SCR) in the South African manufacturing sector.

H_{13}: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on customer’s satisfaction (CS) in the South African manufacturing sector.

H_{14}: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain quality (SCQ) in the South African manufacturing sector.

H_{15}: Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain balance (SCB) in the South African manufacturing sector.

6.5 DESCRIPTIVE STATISTICS OF THE RESEARCH CONSTRUCTS

In this section, the descriptive statistics of research constructs are presented.

Table 6.19: Mean scores and standard deviations of research constructs

Constructs	Sample size (N)	No of items	Means	Minimum	Maximum	Std Deviation	x̄ rank
	Predictor Variable						
GP	402	6	3.7642	1.00	5.00	0.60432	7
ED	402	6	4.0015	1.00	5.00	0.44228	4
GM	402	5	4.0095	1.60	5.00	0.40620	3
GD	402	6	3.8687	1.60	5.00	0.52968	6
RL	402	3	4.2695	2.00	5.00	0.44487	1
PR	402	3	4.1095	2.00	5.00	0.49004	2
LR	402	6	2.4420	1.00	5.00	0.92235	8
GT	402	5	3.9647	1.00	5.00	0.62758	5
Scale: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree							
Mediating Variable							
SCDC	402	5	4.1841	2.20	5.00	0.43916	N/A
Scale: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree							
Outcome Variable							
SCA	402	5	3.9478	2.00	5.00	0.40169	5
SCREL	402	5	3.9607	1.80	5.00	0.41559	3
SCC	402	5	3.9881	1.00	5.00	0.41428	1
CS	402	3	3.8532	1.00	5.00	0.66021	7
SCR	402	3	3.9212	1.00	5.00	0.48375	6
SCQ	402	6	3.9519	1.00	5.00	0.65060	4
SCB	402	6	3.9776	2.33	5.00	0.32157	2
Scale: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree							
GP = Green Purchasing; **ED** = Eco-design; **GM** = Green Manufacturing; **GD** = Green Distribution; **RL** = Reverse Logistics; **PR** = Product Returns; **LR** = legislation and Regulations; **GT** = Green Training; **SCDC** = Supply Chain Dynamic Capabilities; **SCA** = Supply Chain Agility; **SCREL** = Supply Chain Reliability; **SCC** = Supply Chain Costs; **SCR** = Supply Chain Responsiveness; **CS** = Customer Satisfaction; **SCQ** = Supply Chain Quality; **SCB** = Supply Chain Balance.							

Source: Author's own compilation based on data analysis results.

Table 6.19 provides descriptive statistics which include the means, standard deviations of constructs under consideration in the study. A ranking comparison of the mean scores shows that among the predictor variables, RL emerged as the most important GSCMP. Among the outcome variables, SCC had the highest score indicating that it emerged as the most important dimension of SCP.

Each research construct is discussed below.

6.5.1 Descriptive statistics for green purchasing

It appears that GP ranks 7 with an overall mean score of $\bar{x}$ = 3.7642 and a standard deviation of σ = 0.60432. GP mean score scale is closer to the agree point on the Likert-type scale. This suggests that a large proportion of respondents in the South

African manufacturing sector perceive GP as an important tool to achieving environmental sustainability. This observation is echoed by Foo *et al.* (2019) who consider GP as a gatekeeper for a sustainable procurement as well as a mechanism used by manufacturers to control the environmental performance of their suppliers. South African manufacturers are aware of the benefits associated with the implementation of green purchasing and are striving to integrate GP into their supply chains. A study by Bag *et al.* (2020) targeting the South African manufacturing sector with emphasis on the automobile industry reports that South African manufacturing firms are benefiting from the philosophy of incorporating GP in their green strategies since they recognise the vital role it plays in fostering innovative thinking and product development. This shows the importance of GP upstream the supply chain to save costs, improve efficiency, minimise wastes and promote long-term sustainable development.

6.5.2 Descriptive statistics for eco-design

Table 6.19 shows that ED ($\bar{x}$ = 4.0015 & σ = 0.44228) ranks fourth based on statistical means. ED mean score scale is at the range of the agree point on the Likert-type scale. This implies that the majority of respondents agree that their respective companies implement ED. ED represents one dimension of GSCM which enables manufacturing firms to pilot their ecological objectives. Mahlatsi and Chinomona (2020) postulate that ED helps the South African beverage industry to achieve environmental performance through improved efficiency as well as reduced material wastes. This is an indication that ED has the ability to help determine the quality of the raw materials to be used, the energy consumption needed for the operation processes and ensure the effectiveness of waste monitoring and control systems.

6.5.3 Descriptive statistics for green manufacturing

An analysis of Table 6.19 shows that GM ($\bar{x}$ = 4.0095 & σ = 0.40620) had a mean score that stands at the agree point on the Likert-type scale. This suggests that respondents perceive GM as a strategy their companies use to manufacture products with the precise aim of saving resources and minimising wastes of any nature. It is recognised that GM contributes to increase customer base, hence providing economic benefits and reducing the impact of manufacturing activities on the environment (Kwakwa & Adusah-Poku, 2020). The essence of GM can be summarised as an efficient use of resources with low impact on the environment. Given the importance of GM, The Dullah Omer Institute (2021) reports that numerous initiatives to promote the rise of GM have been launched across South Africa. The driving force behind this initiative is the contribution of GM in lowering manufacturing costs and up taking green manufacturing technologies in the manufacturing sector. A study by Bag *et al.* (2021) targeting the South African manufacturing sector demonstrates that GSCM practices which include GM help manufacturers to improve their social, environmental and economic performance.

6.5.4 Descriptive statistics for green distribution

As presented in Table 6.19, GD portrayed a mean score of $\bar{x} = 3.8687$ and a standard deviation $\sigma = 0.52968$. It also appears that GD ranks 6th in terms of its mean score. The computation of GD's mean score shows an inclination towards the 'agree' point on the Likert-type scale which implies that respondents of the South African manufacturing sector perceive some degree of efficient use of resources in their supply chains as a result of the implementation of GD. The importance of GD has been documented for curbing the adverse impact of supply chain activities such as transportation on the environment (Mohtashami *et al.*, 2019). For instance, a study by Christie *et al.* (2021) which investigates the perspective of custom-made apparel manufacturers in Johannesburg, South Africa in matters concerning sustainability reveals that optimising effective routing systems to minimise travel distances during sourcing and distribution products helps manufacturing firms to lower their carbon emissions. Similarly, a study by Mohammed and Wang (2016) shows that GD decreases transportation and implementation costs, fuel consumption, effect on environment, distribution time as a result of choosing the optimum number of facilities locations. This demonstrates that GD helps South African manufacturing companies to achieve their economic and environmental objectives.

6.5.5 Descriptive statistics for reverse logistics

As recorded in Table 6.19, RL ranks number 1 ($\bar{x} = 4.2695$; $\sigma = 0.44487$) with the highest mean score. RL mean score is closer to the agree point on the Likert-type scale, suggesting that the majority of respondents of the South African manufacturing sector were adamant about RL as a constituent of sustainability and perceive that it is a strategy that contributes to improve the performance of their supply chains. A successful implementation of RL requires manufacturing companies to make strategic and tactical decisions at all levels of the supply chain as well as promote cooperation with supply chain members (Pushpamali *et al.*, 2020). Thaba (2017) posits that the importance of RL has been growing within the sustainable development and it is used today by companies as a tool to improve profitability and corporate social image. As a result of the Covid-19 outbreak (dynamic environment), Bag *et al.* (2020) point out that the South African manufacturing sector (more precisely the automotive industry) is changing its approaches to RL to adequately respond to customers' demands by adapting its technologies to match the current context. This adaptation of technologies provides South African manufacturers with an opportunity to increase customer satisfaction and brand loyalty through logistics operations which include effective and efficient workflows in manufacturing operations as well as improved communication and visibility.

6.5.6 Descriptive statistics for product returns

From Table 6.19, it appears that PR which is a new factor generated by the study and deriving from RL was labelled product returns. PR ranks number 2 with a mean score of $\bar{x} = 4.1095$ and a standard deviation of $\sigma = 0.49004$. This mean score places PR in the range of the agree point on the Likert-type scale, suggesting that respondents of the South African manufacturing sector agree and perceive PR as an important measure of sustainable development. This result also suggests that South African manufacturing companies implement PR programmes either for end-of-life products, repairs, or remanufacturing. It is important for companies to develop sound return policies to mitigate customer purchasing risks and promote sales. PR is vital for manufacturers as its implementation provides economic, social and environmental benefits (Shaharudin *et al.*, 2018). Moreover, effective PR programmes and environmentally responsible practices stimulate innovations in sustainability that can help firms be more competitive (Shaharudin *et al*., 2018). For example, Patel (2021) reports in The South African.com that ten SA car brands were recalled in 2021 due to faulty airbags. Another example concerns the Processed Food Manufacturers Enterprise Foods, a subsidiary of Tiger Brands and Rainbow Chicken Limited (RCL) was issued with safety recall notices following the listeriosis outbreak in South Africa (Business & Human Rights Resource Centre, 2018). Such return policies promote healthy relationships between customers and manufacturers, hence improving customer satisfaction and loyalty and providing economic benefits.

6.5.7 Descriptive statistics for legislation and regulations

An analysis of Table 6.19 shows that LR had the lowest mean score with $\bar{x}$ = 2.4420 and the highest standard deviation with σ = 0.92235. LR mean score is closer to the disagree point on the Likert-type scale implying that most of respondents do not perceive that their respective firms implement LR. This further suggests that the majority of respondents felt that there are no external factors that legally compel manufacturing firms to align their strategies with environmental requirements. Not complying with environmental requirements could further damage the level of competitiveness of the South African manufacturing sector which is in decline since 2017 (The global Economic Forum, 2018). South Africa is a signatory of the 2015 Paris accord on climate change in which it has committed to reduce its gas emissions in order to curb the effect of pollution and global warming (Partnership for Action on Green Economy [PAGE], 2018). It is widely recognised that manufacturing operations are vital for the development of emerging economies, however, there is still a debate on their negative impact on the environment (Bag *et al.*, 2018). South Africa is the most polluter in the African continent and is plagued with ramping sustainability issues (Kwakwa & Adusah-Poku, 2020). It is imperative that the South African manufacturing sector adopts and implements green technologies since they contribute to improve the efficiency and effectiveness of operations. Implementing sustainable technologies could result in an improved level of competitiveness globally and continentally in particular.

6.5.8 Descriptive statistics for green training

Looking at Table 6.19, GT displayed a mean score of $\bar{x}$ = 3.9647 and a standard deviation of σ = 0.62758. This places GT at the fifth position in terms of its mean score. GT mean score is leaning towards the agree point on the Likert-type scale implying that respondents of the South African manufacturing sector perceive that their respective firms implement GT. This result demonstrates that South African manufacturers provide GT to their employees with the prime focus on promoting firm values and elevating interests on pollution matters. Jerónimo *et al*. (2019) and Liu *et al.* (2019) describe GT as a powerful tool to achieve environmental sustainability through employee's skill development. It is important to also point out that GT tends to help manufacturing companies to improve their green supply chain management to cooperate with various stakeholders (Teixeira *et al*., 2015). GT allows South African manufacturing companies to raise employee's awareness on sustainability issues and improving employees' skills in green technologies which facilitate the transition to more renewable energy (PAGE, 2017). PAGE (2017) and UNEP (2020) further reports that providing training through skill development programmes helps companies which include South African manufacturers to transition to low-carbon emissions and climate resilient economy.

6.5.9 Descriptive statistics for supply chain dynamic capabilities

Table 6.19 shows that DC had a mean score of 4.1841 and a standard deviation of $\sigma = 0.43916$. The result demonstrates that DC is more inclined towards the agree point on the Likert-type scale. This implies that respondents of the South African manufacturing sector perceive that their respective firms have the ability to develop radical innovative capabilities. Amid the Covid-19 pandemic, respondents felt that DCs contribute to build resilient supply chains and foster the ability of South African manufacturers to rethink their strategies. This is consistent with Bag *et al.* (2021) assertion who allude that during the time of Covid-19 pandemic, technological innovation is helping South African manufacturers to restore and develop a resilient SC through the mitigation of risks and disruptions in their supply chains. Moreover, a study by Wood and Bischoff (2019), targeting the South African Textile industry ascertain that knowledge capabilities help to secure organisational survival and success. Wood and Bischoff (2019) further indicate that DCs represent valuable resources that help manufacturing firms to improve their competitive advantage. This is a clear demonstration that DC is vital for the survival and the financial stability of South African manufacturers.

6.5.10 Descriptive statistics for supply chain agility

The results in Table 6.19 reveal that SCA had an overall statistical mean score of $\bar{x} = 3.9478$ and a standard deviation $\sigma = 0.40169$. The value of the mean is inclined towards the agree point on the Likert-type scale. This suggests that respondents perceive that their supply chains are agile and able to respond timeously to customer requirements while withstanding risk of disruptions. Sangari and Razmi (2015) and Manzoor *et al.* (2021) identify SCA as a key element to successfully compete in dynamic environments since it can change with the varying needs of customers. Moreover, SCA is considered an essential source of efficient and rapid response to dynamics of the market for manufacturing firms to meet customer demands (Manzoor *et al*., 2021). A study by Wu *et al.* (2017) targeting manufacturing companies in Taiwan with more emphasis on electronic industry finds that SCA has the highest influence in enabling manufacturing firms to achieve competitive advantage. An article (editorial) edited by Vorster, (2021) in a pharmaceutical review, reports that efficiency, SCA and a better utilisation of resources allow the pharmaceutical manufacturing to better cater for its customers and ensure the wellbeing of employees since 2019. If well implemented, SCA can enable South African manufacturers to quickly respond to market needs and demands.

6.5.11 Descriptive statistics for supply chain reliability

The overall mean of SCREL scale was $\bar{x}$ = 3.9607 and the value of its standard deviation was σ = 0.41559. This shows an inclination towards the agree point on the Likert-type scale implying that a large number of respondents indicated that they perceive that their supply chains as reliable. This result suggests that respondents felt that their supply chain operations are aligned with customer requirements in terms of speed quality and accuracy. This is consistent with Zhang *et al*.'s (2020) assertion which recognises SCREL as a key player on defining the probability of meeting customer requirements within conditions of time, quantity and quality. Additionally, SCREL is viewed as an important instrument to evaluate order fulfilments, the percentage of orders delivered in full, the timeliness of deliveries to customers, the documentation accuracy and the undamaged state of products (Lu *et al.,* 2016). A study by Dai *et al.* (2021) conducted in China demonstrates that the profit of a manufacturer is increased when it invests in SCREL and traceability. It is vital for South African manufacturers to foster collaboration with their partners and manage redundancy in order to attain SCREL. A study by Mathu and Phetla (2018) conducted in the agri-food industry suggests that supply chain integration using a SCOR model which includes SCREL enhances the response of food fast-moving consumer goods companies and retail chain stores to customers' requirements.

6.5.12 Descriptive statistics for supply chain costs

Highlights on data from Table 6.19 indicate that SCC had a mean score of 3.9881 and a standard deviation of 0.41428, displaying an inclination towards the agree point on the Likert-type scale. The mean score suggests that because of the high level of competitiveness respondents felt that South African manufacturing firms are forced to start competing on cost efficiency and flexibility since the ability to use resources more efficiently provides price benefits. A study by Maiga (2017) indicates that activity-based-cost, internal information systems integration and external information systems integration contribute to reduce the cost of manufacturing firms. Furthermore, a study by Mpwanya and Van Heerden (2017) in the telecommunication industry in South Africa reveals that strategic relationships and collaboration play a vital role of driving down the costs of telecommunications companies. This illustrates that it can be beneficial for South African manufacturers to continuously evaluate their supply chain in order to separate value-added activities from non-value-added activities, identify costs associated with these activities as well as their drivers.

6.5.13 Descriptive statistics for customer satisfaction

From Table 6.19, it appears that CS which is a new factor derived from the SCR scale and labelled customer satisfaction ranks number 7 with a mean score of $\bar{x}$ = 3.8532 and a standard deviation of σ = 0.66021. This mean score places CS in a range of agree point on the Likert-type scale, suggesting that respondents of the South African manufacturing sector agree and perceive that CS is key to improve customer loyalty and sales. The South African manufacturing needs to engage customer to create a long-term sustainable relationship. This is consistent with Gupta and Pandey, (2021) piece of work which places emphasis on customer engagement to improve a firm's performance, builds a favourable reputation and enhance the customer relationship quality. A study by Radder *et al.* (2019), targeting the South African manufacturing finds that service quality, trust and commitment, product quality, commercial aspects and reliability contribute to foster CS. Moreover, a study by Mpwanya and Letsoalo (2019), conducted in the South African manufacturing with more emphasis on the telecommunication industry reveals that service quality influences CS. This is a clear demonstration that CS contributes to achieve competitive advantage through the quality of products and information sharing which reflects accuracy, availability and completeness (Politis *et al.*, 2013). Adopting this policy can constitute a determining factor for South African manufacturers to edge competitors.

6.5.14 Descriptive statistics for supply chain responsiveness

An analysis of Table 6.19 shows that the overall mean score of SCR scale was 3.9212 while its standard deviation was 0.48375. This places SCR in 6th position based on its statistical mean. The value of the mean score portrays a predisposition towards the agree point on the Likert-type scale implying that most respondents perceive that their respective firms are able to make timely decisions to effectively tackle supply chain uncertainties such as delivery delays, unsatisfied customers and lead time problems. This result is in line with Luu's (2016) findings which stipulate that the leadership style and the technological orientation tend to improve the market responsiveness. The study was conducted in the chemical manufacturing industry in Vietnam with the aim of assessing the role of ambidextrous leadership in fostering entrepreneurial orientation and market responsiveness. A study by Bag *et al.* (2018) conducted in the South African manufacturing sector finds that despite the dire state of the South African economy, South African manufacturers were able to improve their SCR through flexibility and resilience. It is important to indicate that core capabilities of any given manufacturing firm reside in its ability to respond effectively to market changes.

6.5.15 Descriptive statistics for supply chain quality

The overall mean score of the SCQ scale in Table 6.19 was $\bar{x}$ = 3.9519 while its standard deviation was σ = 0.65060. This statistical mean score places SCQ in the range of the agree point on the Likert-type scale, suggesting that respondents of the South African manufacturing sector at large agree and perceive that the products which derive from their supply chains provide guarantee safety, attractiveness and environmentally friendly features. Quality plays an important role in enforcing the credibility, image of firms and it is at the core of the competitiveness (Yu *et al.*, 2017; Yu & Huo, 2018). A study by Jacobs and Mafini (2019), targeting the fast-moving consumer goods industry in Gauteng, South Africa suggests that manufacturers are improving the quality of their products as a result of their leadership styles. This suggests leaders of the manufacturing are monitoring their supply chains closely to ensure that SC members at different stages of their operations and throughout the entire network fully comply with spelt specifications and standards to achieve higher SCQ.

6.5.16 Descriptive statistics for supply chain balance

The computed results in Table 6.19 reveal that SCB had an overall statistical mean score of $\bar{x}$ = 3.9776 and a standard deviation σ = 0.32157 holding the 2^{nd} position based on its statistics mean. The value of the mean is inclined towards the agree point on the Likert-type scale. This suggests that respondents perceive that their companies promote an atmosphere that is conducive for collaboration and cooperation with suppliers while mitigating risks and opportunism. This is consistent with Mathu and

Phetla's (2018) work which concludes that the success of fast-moving consumer goods companies in South Africa is a result of coordination and collaboration between supply chain partners. Moreover, a study by Modungwa *et al.* (2021) conducted in the South African automotive industry suggests that strategic relationships with suppliers enhances innovation capabilities of the automotive manufacturing industry through collaboration, transparency and resource sharing. Manufacturers indicated that suppliers were able to adapt and synchronise with their innovation initiatives. The study shows the importance that coordinated activities play in the sphere of the manufacturing in South Africa.

6.6 TESTS FOR NORMALITY OF DATA

Data normality can be described as a distribution of data for a specific variable (Anwar *et al.*, 2018). Normally distributed data can also be symmetrical, implying that the left half is the mirror of the right half and vice versa and fifty percent of the distribution lies in each half (Wagner, III & Gillespie, 2019). Assessing the violation of the assumption of normality can be performed through the measure of dispersion, skewness and kurtosis (Huxley, 2020). The measure of dispersion requires the use of descriptive statistics such as mean and variance. The skewness refers to as the shift of the distribution to one side [left] or the other and vice versa [right] (Knapp, 2019) while the kurtosis describes the peakedness of the distribution such as to how flat a distribution is based on its tails and peak (Wagner *et al.*, 2019; Frieman *et al.*, 2022).

There is no consensus among scholars in determining the magnitude of non-normality of a distribution. Wagner *et al.* (2019) suggest +/- 1.9 for the skewness and +/- 3.0 for the kurtosis (Breslin, 2020; Longest, 2020) while Anwar et al., (2018) propose +/- 2.0 for the skewness and the kurtosis. Farmer and Farmer (2022) suggest a kurtosis of +/- 3 and a highly skewed distribution with a cut-off score of +/-1.0. The study adopted Anwar *et al'*s (2018) approach which requires a distribution to demonstrate a skewness of +/- 2.0 and a kurtosis value of +/- 2.0. Table 6.20 provides a range of information on the distribution of data and whether data follow a normal distribution or whether the data suffer from skewness or kurtosis syndrome.

Table 6.20: Skewness and kurtosis scores of study constructs

Construct	Valid cases	Missing cases	Skewness			Kurtosis		
			Sig.	Test Statistic	Std. Error	Sig.	Test Statistic	Std. Error
GP	402	0.000	0.000	-1.637	0.122	0.000	3.357	0.243
ED	402	0.000	0.000	-2.451	0.122	0.000	14.435	0.243
GM	402	0.000	0.000	-1.242	0.122	0.000	5.921	0.243
GD	402	0.000	0.000	-1.821	0.122	0.000	3.906	0.243
RL	402	0.000	0.000	0.424	0.122	0.000	0.714	0.243
PR	402	0.000	0.000	-0.836	0.122	0.000	3.616	0.243
LR	402	0.000	0.000	0.764	0.122	0.000	-0.118	0.243
GT	402	0.000	0.000	-1.807	0.122	0.000	5.078	0.243
SCDC	402	0.000	0.000	-0.222	0.122	0.000	2.170	0.243
SCA	402	0.000	0.000	-1.299	0.122	0.000	4.868	0.243
SCREL	402	0.000	0.000	-1.853	0.122	0.000	7.468	0.243
SCC	402	0.000	0.000	-2.475	0.122	0.000	13.708	0.243
CS	402	0.000	0.000	-1.720	0.122	0.000	3.563	0.243
SCR	402	0.000	0.000	-2.215	0.122	0.000	8.981	0.243
SCQ	402	0.000	0.000	-1.910	0.122	0.000	5.058	0.243
SCB	402	0.000	0.000	-1.504	0.122	0.000	5.615	0.243

GP = Green Purchasing; **ED** = Eco-design; **GM** = Green Manufacturing; **GD** = Green Distribution; **RL** = Reverse Logistics; **PR** = Product Returns; **LR** = legislation and Regulations; **GT** = Green Training; **SCDC** = Supply Chain Dynamic Capabilities; **SCA** = Supply Chain Agility; **SCREL** = Supply Chain Reliability; **SCC** = Supply Chain Costs; **SCR** = Supply Chain Responsiveness; **CS** = Customer Satisfaction; **SCQ** = Supply Chain Quality; **SCB** = Supply Chain Balance.

Source: Data imported from SPSS (2022).

A glance on Table 6.20 shows that the data of all constructs do not possess the characteristics of a normal distribution.

6.6.1 Skewness of data

As shown in Table 6.20, the measures of the skewness statistics of constructs ranged from – 2.475 to 0.764 with most measures being negative suggesting that the distribution was negatively skewed. This means that tails were directed towards the left side of curves. Such scores are deemed not to meet the requirements of a normally distributed data.

6.6.2 Kurtosis of data

The values of the kurtosis ranged from – 0.118 to 14.435 with most values not contained within the recommended score of +/- 2.0 except for RL which had a score of - 0.118. Since the scores of the kurtoses fell outside the accepted scores set by the study, it was deduced that these measures indicate that the distribution height was leptokurtic (more peaked than the normally distributed data). Moreover, the shape of the curve indicates that the data contained extreme values which are significantly different from zero.

Considering the combination of the skewness and the kurtosis, one can conclude that the data captured for the study were not normally distributed, thus requiring data transformation to achieve normal approximations. If data transformation is not done to adjust the distribution values obtained during the test of normality, the study may be exposed to Type I or II errors which are linked to hypothesis testing (Wagner *et al.*, 2019; Huxley, 2020). A Type I error occurs when a statistical association is not identified but do exist or is true, whereas a Type II error occurs when a statistical association is identified when it does not exist (Huxley, 2020). Data transformation can help reduce the likelihood of occurrence of such errors, hence improving the statistical power, the quality and accuracy of research findings (Osborne, 2019).

6.6.3 Potential reasons for extreme values

The values of the skewness and kurtosis clearly confirmed that the data did not fulfil the requirements of data normality. The scores obtained suggest the presence of outliers or extreme values which contributed to violate the principles of normality (Longest, 2020; Frieman *et al*., 2022). Knapp (2019) and Huxley (2020) ascertain that, extreme values may include one of the followings:

- error may have happened during the data collection phase (i.e. editing of data). The original spreadsheet was verified again and again to rule out any errors and all entries were found to be free of errors, thus valid.
- respondents may have misreported or purposely provided an illegitimate response. Since the survey was conducted online and respondents were responding anonymously it was difficult to contact them again. It is important to point out the links were not only shared by the researcher but also by fellow colleagues of all individuals who partook in the study.
- sample bias may have originated from the responses (Wagner *et al.*, 2019).

These outliers are known to affect data analysis substantially; therefore, it is important to find ways to minimise their effects of the findings.

6.6.4 Methods of reducing the influence of extreme values

As presented in Table 6.20, the mean and the standard deviation displayed acceptable scores with exception of the skewness and the kurtosis which had values outside the recommended ranges. Rodriguez (2020) postulates that there is nothing inherently wrong when data do not follow a normal distribution. There are simply variables that are not distributed to the model. Rodriguez (2020) further proposes options that include non-parametric tests (Mann–Whitney, U test known as "Wilcoxon Rank-Sum test", Kruskal–Wallis test) and data transformation (decimal logarithm or a square root) as alternative methods to normalise data that do not follow a normal distribution (see Table 6.21). Non-parametric tests (variance based-SEM – PLS) do not require the data to be normally distributed whereas parametric tests which are covariance-based SEM require the data to meet the data normality requirements (Awang *et al.*, 2015). Regarding data transformation, Wagner *et al.* (2019) and Huxley (2020) ascertain that using a logarithm decimal can help meet the assumption of normality. It is relevant to suggest that once the transformed data are normally distributed, parametric tests such as regression and ANOVA can be performed (Huxley, 2020). Table 6.21 portrays the techniques to be used to achieve data normality.

Table 6.21: Techniques to adjust non-normal distribution

Parametric test	Non-parametric test	Data transformation
Student's t-test	Mann–Whitney, U test	Decimal logarithm
One-way ANOVA	Kruskal–Wallis test	Square root
Regression analysis	Spearman's rho	Box-Cox

Source: Huxley, (2020) and Rodriguez (2020).

Table 6.21 provides a summary of alternative options to data that do not follow a normal distribution. These tests allow data to meet the assumption of normality or to achieve normal distribution.

Data transformation was done to improve the validity of test results followed by one way ANOVA test. Table 6.22 shows the transformed skewness and kurtosis and the resulting scores.

Table 6.22: Transformed skewed and kurtosis variables

Construct	Valid cases	Missing cases	Min statistic	Max statistic	Transformed skewness	Transformed kurtosis
GP	402	0.000	1.00	5.00	0.639	0.523
ED	402	0.000	1.00	5.00	0.550	1.159
GM	402	0.000	1.60	5.00	0.677	0.772
GD	402	0.000	1.60	5.00	0.621	0.591
RL	402	0.000	2.00	5.00	0.153	0.234
PR	402	0.000	2.00	5.00	0.712	0.558
LR	402	0.000	1.00	5.00	0.246	0.769
GT	402	0.000	1.00	5.00	0.622	0.705
SCDC	402	0.000	2.20	5.00	0.761	0.336
SCA	402	0.000	2.00	5.00	0.672	0.687
SCREL	402	0.000	1.80	5.00	0.617	0.873
SCC	402	0.000	1.00	5.00	0.547	1.136
CS	402	0.000	1.00	5.00	0.631	0.551
SCR	402	0.000	1.00	5.00	0.578	0.953
SCQ	402	0.000	1.00	5.00	0.611	0.703
SCB	402	0.000	2.33	5.00	0.652	0.749

GP = Green Purchasing; **ED** = Eco-design; **GM** = Green Manufacturing; **GD** = Green Distribution; **RL** = Reverse Logistics; **PR** = Product Returns; **LR** = legislation and Regulations; **GT** = Green Training; **SCDC** = Supply Chain Dynamic Capabilities; **SCA** = Supply Chain Agility; **SCREL** = Supply Chain Reliability; **SCC** = Supply Chain Costs; **SCR** = Supply Chain Responsiveness; **CS** = Customer Satisfaction; **SCQ** = Supply Chain Quality; **SCB** = Supply Chain Balance.

Positive skewness Y= Log (score in variable)

Negative skewness Y= [Log (Max value+1) – score in variable]

Variable with zero value: Y = Log (score in variable + 1) as per Huxley, (2020)

Source: Data imported from SPSS, (2022).

Table 6.22 reveals optimum scores of skewness (0.153 to 0.761) close to zero were obtained as well as acceptable values for kurtoses ranging (0.234 to 1.159) within the recommended score of +/- 2.0 suggesting that the data were normally distributed after transformation and, accordingly, they were applicable to be used in parametric tests.

6.6.5 Normality of data when using smart partial least squares

Though data were transformed to obtain optimum values of skewness and kurtosis (see Table 6.22) as a result of not meeting the assumption of normality, the researcher found appropriate to take precautionary measures by using a statistical programme (Smart partial least squares programme – Smart-PLS) that is less sensitive to non-normality. Smart-PLS has been gaining popularity because of its ease of use, advanced features and it does not require assumptions such as normality of data and can be used not only for large size samples but also for small sizes (Groß, 2018; Lestari, 2019). Consistent with this statement, Ferine *et al.* (2021) also ascertain that Smart-PLS is desirable to many researchers since it provides estimates of complex models with many constructs, indicators and structural paths without having to force distributional assumptions on the data. Dash and Paul (2021) argue that it is the variance approach rather than the covariance that makes Smart-PLS popular among scholars. The authors ascertain that Smart-PLS verifies alternate models to find the most appropriate relationship among the unobserved variables and provides quick estimates of the cause-and-effect relationships. In addition, Smart-PLS provides more flexibility to explore and experiment with numerous configurations and can effectively handle complex mediation analysis and CFA (Dash & Paul, 2021). Smart-PLS can be characterised a prediction-oriented and theory development software that is appropriate for studies that have not been well examined yet (Groß, 2018; Dash & Paul, 2021). Moreover, it combines features from the principal component and multiple regression analyses that ensure that the results are sound and robust (Hernández-Perlines, 2019).

6.7 COMMON METHOD BIAS AND MULTICOLLINEARITY

For the current study, it was important to ensure the validity of the findings and rule out any possibilities of common method bias (CMB) between dependent and independent variables by conducting a CBM test. To address these possibilities, the study performed procedural and statistical remedies.

6.7.1 Procedural remedy

The questionnaire comprised five sections and each section were preceded by an introductory statement before attempting to respond to questions. The aim of this setup was to provide clarity to respondents that the measurement of the predictor variable was not linked to the measurement of the response variable. The study used different Likert scales to measure responses and ensured that identities of respondents were not disclosed. Respondents were asked to simply respond to questions since there was no true or false answers to each question. Moreover, a pilot test was conducted to remove all ambiguities before the effective collection of data and results are presented in Section 6.2.

6.7.2 Statistical remedy

The study conducted the Harman's single factor to check for CMB. The generated principal component analysis output revealed 18 different factors accounting for 74.559% of the cumulative variance. However, the first unrotated factor captured only 26.390% of the variance in data. Furthermore, no single factor appeared and the first factor did not capture most or more than 50% of the variance as recommended by AlNuaimi *et al.*, (2021) and Hasan and Bao (2021). In addition, the study used Smart-PLS to assess the multicollinearity problem. The outcome of the collinearity test revealed that the variance inflation factor (VIF) of each construct was below 5.0 (Leong *et al.*, 2020; Mandhani *et al.*, 2020). The values of VIF ranged from 1.393 to 4.415 indicating that there was no multicollinearity problem. Accordingly, the data was considered to be free from CMB.

6.8 INFERENTIAL STATISTICS

After bringing forth the descriptive statistics of the study sample, inferential statistics remain the last masterpiece to the edifice that will help to draw a conclusion about the entire population of interest. Inferential statistics provide a platform for researchers to make inferences about a specific population based on the sample data drawn (Christopher, 2021; Ruel, 2021). Inferential statistics can be described as numeric indices from the observed data which are used to make inferences (Seaman, 2018; Ewuzie *et al.*, 2021). Moreover, inferential statistics can allow to make sound conclusions about the implementation of GSCM in the South African manufacturing sector.

To analyse the revised conceptual framework, a partial least square structural equation modelling (PLS-SEM) approach was performed using a Smart-PLS 3 programme. This was done because the data did not follow the normal distribution prior the data transformation. Using Smart-PLS required two phases; the first phase needed testing the measurement scale for reliability and validity (see Table 6.23) while the second phase involved examining the structural model and hypotheses (Groß, 2018; Dash & Paul, 2021). Smart-PLS helps define if hypotheses are consistent with the sample, if it is the case they are retained as a tenable value for the parameter, the entire population (Dash & Paul, 2021). The path model established the relationship between observed and unobserved variables. The study also used path model to examine the mediating role of SCDCs in the relationships between GSCM practices and SCP in the South African manufacturing sector.

6.8.1 Evaluation of the measurement scale

It is necessary to evaluate a measurement tool since it needs to possess specific psychometric properties that provide objective assessment. Reliability and validity constitute the most important psychometric properties that must be included in measurement tools to ensure that the data analysis produces accurate results (Nartgün & Şahin, 2015). The evaluation consisted of meeting quality criteria which included the reliability of each variable, the internal consistency (Cronbach's alpha and composite reliability), the construct validity, the convergent validity (average variance extracted – AVE) and the discriminant validity (Hussain & Endut, 2018). The results of this criteria are presented in Table 6.23.

Table 6.23: Accuracy analysis statistics

Research Construct		Cronbach's test		Rho A	CR	AVE	$\sqrt{AVE}$	Factor loading
		Item-total	α					
GP	GP1	0.405	0.812	0.836	0.866	0.565	0.751	0.642
	GP2	0.618						0.821
	GP3	0.652						0.730
	GP4	0.673						0.820
	GP5	0.579						0.787
ED	ED1	0.733	0.905	0.915	0.929	0.725	0.851	0.855
	ED2	0.761						0.856
	ED3	0.754						0.875
	ED4	0.754						0.869
	ED5	0.744						0.814
GM	GM1	0.615	0.834	0.849	0.882	0.602	0.775	0.765
	GM2	0.684						0.813
	GM3	0.577						0.734
	GM4	0.737						0.851
	GM5	0.554						0.713
GD	GD2	0.664	0.862	0.896	0.897	0.637	0.798	0.782
	GD3	0.580						0.665
	GD4	0.726						0.853
	GD5	0.743						0.862
	GD6	0.759						0.877
RL	RL2	0.714	0.821	1.127	0.871	0.693	0.832	0.854

	RL3	0.712						0.855
	RL4	0.680						0.822
**PR	PR1	0.653	0.666	0.826	0.803	0.585	0.764	0.758
	PR5	0.538						0.641
	PR6	0.542						0.637
LR	LR1	0.351	0.831	0.847	0.897	0.744	0.862	0.808
	LR2	0.520						0.913
	LR4	0.567						0.879
GT	GT1	0.771	0.929	0.931	0.946	0.779	0.882	0.852
	GT2	0.852						0.909
	GT3	0.864						0.919
	GT4	0.845						0.906
	GT5	0.756						0.842
SCDC	SCDC1	0.680	0.863	0.888	0.900	0.644	0.802	0.806
	SCDC2	0.717						0.829
	SCDC3	0.621						0.756
	SCDC4	0.770						0.867
	SCDC5	0.634						0.768
SCA	SCA1	0.564	0.809	0.842	0.859	0.552	0.742	0.749
	SCA2	0.570						0.745
	SCA3	0.574						0.747
	SCA4	0.642						0.765
	SCA5	0.639						0.767
SCREL	SCREL1	0.703	0.881	0.890	0.912	0.675	0.821	0.816
	SCREL2	0.700						0.809
	SCREL3	0.737						0.841
	SCREL4	0.718						0.825
	SCREL5	0.727						0.832
SCC	SCC1	0.733	0.927	0.932	0.945	0.775	0.880	0.824
	SCC2	0.867						0.920
	SCC3	0.819						0.888
	SCC4	0.837						0.901
	SCC5	0.803						0.877
**CS	CS1	0.680	0.879	0.911	0.924	0.803	0.896	0.785
	CS2	0.711						0.812
	CS3	0.733						0.831
SCR	SCR4	0.481	0.792	0.799	0.877	0.705	0.839	0.623
	SCR5	0.594						0.728
	SCR6	0.649						0.769

SCQ	SCQ3	0.473	0.883	0.987	0.925	0.805	0.897	0.861
	SCQ5	0.497						0.910
	SCQ6	0.638						0.924
SCB	SCB1	0.596	0.804	0.812	0.859	0.504	0.709	0.732
	SCB2	0.599						0.730
	SCB3	0.572						0.714
	SCB4	0.451						0.617
	SCB5	0.639						0.785
	SCB6	0.515						0.687

** Product returns= new factor extracted from Reverse Logistics
** Customer Satisfaction= new factor extracted from SCR
GP = Green Purchasing; **ED** = Eco-design; **GM** = Green Manufacturing; **GD** = Green Distribution; **RL** = Reverse Logistics; **PR** = Product Returns; **LR** = legislation and Regulations; **GT** = Green Training; **SCDC** = Supply Chain Dynamic Capabilities; **SCA** = Supply Chain Agility; **SCREL** = Supply Chain Reliability; **SCC** = Supply Chain Costs; **SCR** = Supply Chain Responsiveness; **CS** = Customer Satisfaction; **SCQ** = Supply Chain Quality; **SCB** = Supply Chain Balance.

Source: Author's own compilation based in data analysis results (2022).

Table 6.23 shows the measurement scale results for reliability and validity.

6.8.1.1 Analysis of the reliability

Reliability refers to the ability of an instrument to measure with accuracy what it is supposed to repeatedly and it is often understood as a precondition for validity (Marquart, 2017). Reliability also refers to the consistency of the measurement to produce identical results (Frey, 2018). In PLS-SEM, the values of reliability are organised according to their indicator's individual reliability. The values range from 0 to 1, where a higher value indicates higher reliability level (Ab Hamid *et al.*, 2017). The reliability was ascertained through item-total correlation, Cronbach alpha, Rho_A and composite reliability.

6.8.1.1.1 Item total correlation

Item-total correlation represents the contribution of each item to the instrument consistency as determined by the ability to discriminate between high and low scoring individuals (Wang *et al.*, 2017). Item-total correlation was used to illustrate the coherence aspect between items. Based on Seydi *et al.*'s (2021) and Ozsahin and Derya's (2022) studies, correlation coefficients greater than 0.3 were considered acceptable. The scale item-total correlation scores presented in Table 6.23 show a good relationship of items with the dimensions. Items exhibited satisfactory scores above 0.3 and ranged from 0.351 to 0.867. GT and SCC items showed higher scores while one item of LR (item 1) was less correlated with an index score of 0.351. This suggests that all measurement scales were internally consistent.

6.8.1.1.2 Cronbach's alpha

Cronbach's alpha represents the most common test score reliability coefficient for single administration (Huang *et al.*, 2022). It is important to note during the reliability checks the following items were removed to improve the reliability; Item GP 6 was removed to improve the reliability from 0.775 to 0.812; item ED6 was discarded to improve the reliability from 0.876 to 0.905; Items LR3, LR5 and RL6 were deleted to improve the reliability from 0.555 to 0.831. Items SCQ1, SCQ2 and SCQ4 were removed to improve the scale reliability from 0.670 to 0.883. Cronbach's alpha coefficient was evaluated through the internal consistency on each construct. Values of Cronbach's alpha shown in Table 6.23 were all above the threshold of 0.6 (Ferine *et al*., 2021; Kholed *et al.*, 2021) and ranged from 0.666 to 0.929. The new factor extracted from RL (Product return) scale demonstrated slightly lower score but was deemed meeting the criteria of internal consistency with a Cronbach alpha $\alpha = 0.666$. This suggests that the requirements of internal consistency were met.

6.8.1.1.3 Rho A

The reliability of PLS constructs was also assessed using Rho_A reliability. Rho_A is used to evaluate the weight of constructs, not their loadings and it is represented by the off-diagonal elements of a latent variable's indicator correlation matrix that are reproduced (Van Nguyen & Habok, 2021). The reliability analysis demonstrated that the measurement scales exhibited Rho_A scores greater than the recommended value of 0.7 (Van Nguyen & Habok, 2021) except for RL which displayed a value greater than 1.0 (1.127). Obtaining such value is a concern and should not have occurred in principle. Since Rho_A is also a CR indicator computed on unstandardised loadings (Paude & Kumar, 2021), the CR of RL (0.871) was considered instead in this particular case. It is then concluded that the result demonstrates adequate level of composite reliability.

6.8.1.1.4 Composite reliability

Composite reliability is described as a measure of internal consistency in scale items (Hair et al., 2017). CR scores vary between 0 and 1 with scores close to 1 highly desirable since they indicate higher reliability. Composite reliability should exceed the value of 0.7 (Hernández-Perlines, 2019; Kholed *et al*., 2021). The results in Table 6.23 show that all values of composite reliability consistently exceeded the threshold of 0.7; therefore, they indicate internal consistency of the constructs used in the study.

6.8.1.2 Validity analysis

Validity refers to the extent to which a survey instrument adequately reflects what it is designed to measure (Frey, 2018). Validity plays an important role in research projects and must be taken into consideration when evaluating the ability of a survey instrument to capture what it was designed for. The tests of validity consisted of the face validity, content validity, convergent validity and discriminant validity.

6.8.1.2.1 Face validity

Face validity describes the ability of a panel to evaluate and report on the effectiveness of a survey instrument to measure what it is supposed to measure (McGregor, 2019). Face validity was initially assessed based on opinions of three individuals who had intensive knowledge and experience in SCM. They included a quality manager, a managing director and one logistics manager. These individuals were asked to review the questionnaire and provide constructive feedback on spelling mistakes, clarity and simplicity of the questionnaire. Their recommendations were considered where applicable. The revised and final questionnaire was then sent to the research supervisor for final review to ensure it effectively measured what it was designed to measure.

6.8.1.2.2 Content validity

Content validity refers to the assessment of the content of a measurement scale based on the solicited opinions of researchers and experts (Frey, 2018). The survey instrument was sent to 50 SC professionals from the South African manufacturing sector who were not included in the final sample. A convenient sampling was used to select these respondents across the four provinces of interest which included Gauteng, Free State, Mpumalanga and Limpopo. The pilot test suggested that expressions in the scale were found comprehensible. Section 6.2 of this chapter provides a comprehensive discussion on the pilot test conducted and its results are presented in Table 6.2. No scale items were deleted since their scores were sufficient (>0.60) to determine that the questionnaire had a good internal consistency reliability. Moreover, the corrected item-total correlations had values above the cut-off value of

0.3 as recommended by Daud *et al.* (2018), EL Hajjar (2018), Seydi *et al*. (2021) and Ozsahin and Derya (2022). The results suggested that the survey instrument was found suitable for assessing the implementation of GSCM practices in the South African manufacturing sector.

6.8.1.2.3 Convergent validity

Convergent validity is a process that allows the researcher to measure the level of correlation of multiple indicators of the same construct that are in agreement (Ab Hamid *et al*., 2017). Convergent validity was established through factor loading of items and the AVE (Kholed *et al*., 2021). As indicated in Table 6.23, the factor loadings of all items exceeded the cut-off value of 0.50 (Lestari, 2019) and ranged from 0.617 to 0.924 whereas the AVE of constructs exhibited values equal or greater than 0.50 as recommended by Fadhel *et al.*, (2019) and Prasojo *et al.* (2021) and ranged from 0.504 to 0.805. This suggests that the results evidenced the convergent validity.

6.8.1.2.4 Discriminant validity

Discriminant validity provides evidence in a sense that constructs that should not be related do not in fact have any relationship whatsoever (Hussain & Endut, 2018; Reinecke & Pöge, 2020). In order to evaluate the discriminant validity of constructs in Smart PLS model, the Fornel and Larcker criterion was used to compare the square root of each AVE in the diagonal with the correlation coefficients for each construct in the relevant rows and columns (Çakıt *et al*., 2020). A latent construct must explain better the variance of its own indicators rather than the variance of other latent constructs. Therefore, the square root of each construct's AVE must have a greater value than the correlations with other latent constructs. As evidenced in Table 6.24, it can be concluded that the correlations between constructs do not exceed the value of the square root of the AVE of each construct.

Table 6.24: Discriminant validity analysis

	ED	GD	GM	GP	GT	LR	CS	PR	RL	SCA	SCB	SCC	SCDC	SCQ	SCR	SCREL
ED	**0.851**															
GD	0.435	**0.798**														
GM	0.709	0.487	**0.776**													
GP	0.550	0.533	0.611	**0.752**												
GT	0.472	0.324	0.570	0.546	**0.882**											
LR	-0.172	-0.118	-0.236	-0.356	-0,390	**0,863**										
CS	0.232	0,443	0.160	0.217	0.168	-0.025	**0.896**									
PR	0.500	0.38	0.504	0.386	0.385	-0.231	0.220	**0.765**								
RL	0.367	0.230	0,426	0.222	0,254	-0.170	0.071	0.621	**0.832**							
SCA	0.460	0.458	0.429	0.344	0.387	-0.170	0.436	0.413	0.210	**0.743**						
SCB	0.530	0.472	0.463	03.54	0.426	-0.177	0.318	0.477	0.340	0.509	**0.710**					
SCC	0.515	0.338	0.460	0.330	0.412	-0.25	0.464	0.429	0.293	0.588	0.483	**0.881**				

SCDC	0.467	0.391	0.453	0.404	0.491	-0.232	0.238	0.412	0.313	0.434	0.510	0.413	**0.803**			
SCQ	0.068	0.308	0.040	0.099	0.028	0.049	0.669	0.012	-0.126	0.346	0.110	0.250	0.111	**0.897**		
SCR	0.205	0.407	0.244	0.292	0.281	-0.167	0.518	0.163	0.128	0.476	0.378	0.403	0.223	0.365	**0.839**	
SCREL	0.507	0.388	0.416	0.342	0.337	-0.107	0.484	0.467	0.270	0.644	0.552	0.696	0.447	0.239	0.428	**0.822**

Source: Author's own compilation based on data analysis results

The correlation coefficients between constructs are summarised in Table 6.24 and based on these results, it is clear that discriminant validity between constructs was well established.

6.8.1.3 R-squared statistics

R-squared is a commonly used measurement tool to evaluate a structural model. It represents the exogenous latent variables' combined effects on the endogenous latent variables (Hair, Jr. *et al.*, 2017). R-squared (R^2) indicates how much of the total variance in the dependent variable can be explained by the independent variable (Paudel & Kumar, 2021). The value of R^2 ranges from 0-1 with higher levels indicating greater degree of predictive accuracy. Literature suggests that R^2 should be equal or greater than 0.10 so that a certain endogenous building variance is considered acceptable (El Hilali *et al.*, 2020; Lee *et al.*, 2021; Paudel and Kumar, 2021). Table 6.25 portrays the predictive power of independent variables on dependent variables.

Table 6.25: Predictive power

Dependent variables	R square	R square adjusted
Supply chain agility	**0.188**	**0.186**
Supply chain reliability	**0.200**	**0.198**
Supply chain costs	**0.170**	**0.168**
Supply chain responsiveness	0.050	0.047
Customer satisfaction	0.057	0.054
Supply chain quality	0.012	0.010
Supply chain balance	**0.260**	**0.258**
Supply chain dynamic capabilities	**0.358**	**0.345**

Source: Author's own compilation based on data analysis results.

As displayed in Table 6.25, the R^2 coefficient for SCDC is 0.358 implying that the eight predictor variables explain 35.8% of the variance of SCDC. The remaining 64.2% of the variance is accounted by other factors that were not considered in the study. Likewise, SCA, SCREL, SCC and SCB were found to play a role with R^2 greater than

0.10 indicating that more than 10% of these variables were predicted by GSCMP through SCDC. However, GSCMP had a weak predictive effect on SCR, CS and SCQ through the mediating role of SCDC suggesting that these three constructs failed to model the data. Since most of the values were above the threshold limit of 0.10, the study can suggest that endogenous constructs can be explained by the connected predictor constructs in the model. Thus, the study concludes that the model had a very good predictive capacity that explained the variation in SCDC with regard to GSCMP indicators engaged.

6.8.1.4 Model fit analysis

Various fit assessment tools are used to demonstrate the manner in which a conceptual model fits the collected data (Kevin, 2017; Allen, 2018). Each statistical test gives an indication of how well (or poorly) the model-implied covariance matrix reproduces the observed matrix (Allen, 2018). The overall fit of the model was assessed through the features generated by Smart PLS which included the standardised root mean square residual with (SRMR) and the normed fit index (NFI) presented in Table 6.25. Generally, SRMR values should be between 0.08 and 0.10 to avoid model misspecification (Dash & Paul, 2021; Hasan & Bao, 2021). The model is considered perfect fit when SRMR is close to 0. Furthermore, it is recommended that the NFI falls between 0 and 1 and the more it approaches 1 the better the model fit (Nguyen & Habok, 2021). The chi-square is considered as a badness of fitness because its value increases with an increase in sample size and number of indicators (Dash & Paul, 2021). Table 6.26 provides a summary of the model fit assessment.

Table 6.26: Summary of the model fit

Estimated Model	Value
SRMR	0.100
Chi-Square	10526.295
NFI	0.910

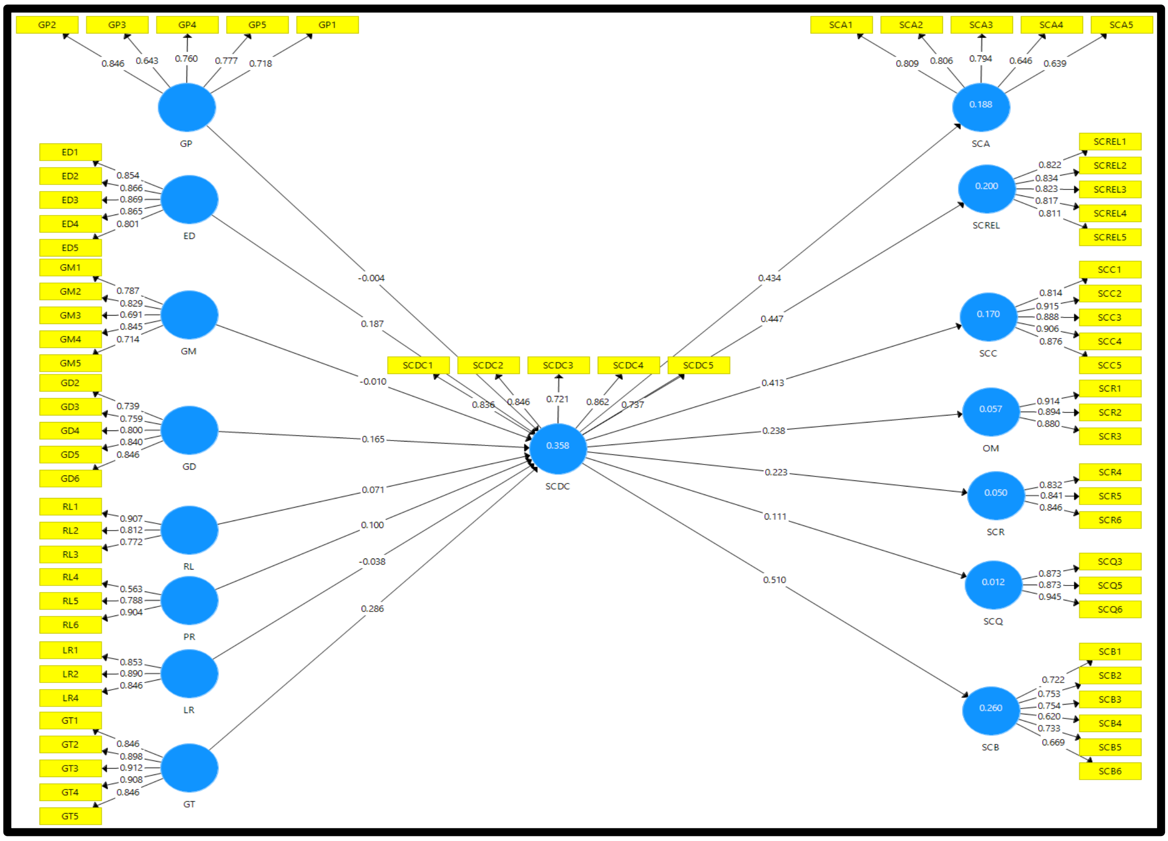
Source: Author’s own compilation based on data analysis results.

As shown in Table 6.26, the SRMR and NFI of the structural model are 0.100 (= 0.10) and 0.910 (< 0.95), respectively, which show an acceptable overall goodness-of-fit. Therefore, the model did achieve excellent goodness-of-fit.

6.8.1.5 Results for the hypothesis tests

The structural model evaluation was done to test the paths among constructs based on the stated hypotheses. It is important to indicate that the outcome of the path analysis was generated through Smart-PLS and results are displayed in Figure 6.25. The study used 0.05 significant level to produce the standard error as recommended by Çakıt *et al*. (2020) and Ferine *et al*. (2021).

Figure 6.25 Path model



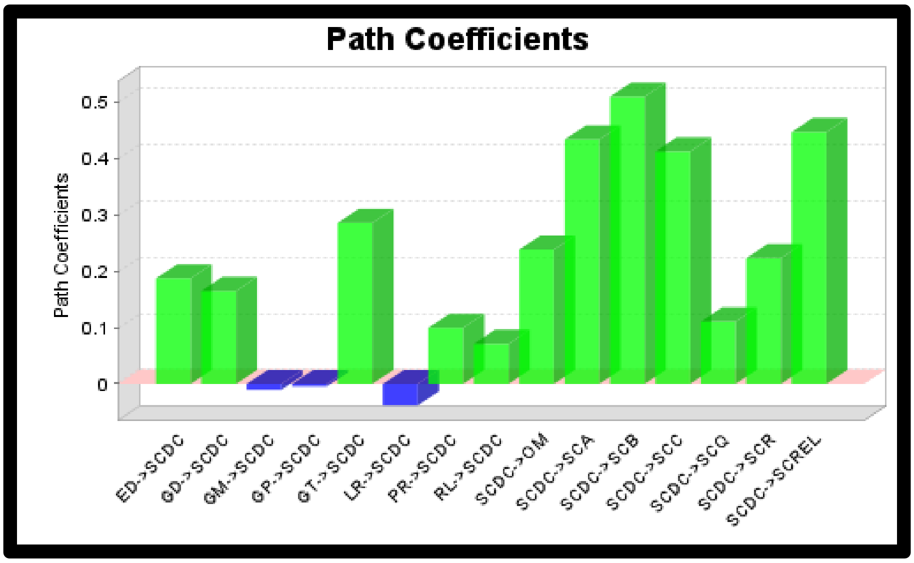
Source: Imported from Smart-PLS analysis (2022).

Figure 6.25 shows the results of Smart-PLS with construction of pathways based on sixteen variables. Also displayed are item loadings of the outer model and pathway coefficients (p-values) obtained from the analysis.

6.8.1.6 Path coefficients

Figure 6.26 illustrates the individual strength of the path coefficients.

Figure 6.26: Path coefficients



Source: Imported from Smart-PLS analysis (2022).

Figure 6.26 depicts the path coefficients of the relationship between latent and observed variables. It can be seen that the GP, GM and LR exerted a negative effect on SCDC whereas all other relationships were positively related.

6.8.1.7 Hypothesis test results

The structural relationships between constructs are compared in Table 6.27. If $p < 0.05$; the hypothesis is supported, otherwise it is deemed rejected. The path coefficients and p-values were calculated using Smart-PLS.

Table 6.27: Results of structural equation model analysis

Path	Hypothesis	Path coefficient (β)	T-statistics (t)	Significance (p)	Decision
GP → SCDC	H1	-0.004	0.079	0.937	Not supported and not significant
ED → SCDC	H2	0.187	2.717	0.007	Supported and significant
GM → SCDC	H3	-0.010	0.143	0.886	Not supported and not significant
GD → SCDC	H4	0.165	3.114	0.002	Supported and significant
RL → SCDC	H5	0.071	1.276	0.202	Not supported and not significant

PR → SCDC	H6	0.100	1.715	0.087	Not supported and not significant
LR → SCDC	H7	-0.038	1.276	0.421	Not supported and not significant
GT → SCDC	H8	0.286	5.289	0.000	Supported and significant
SCDC → SCA	H9	0.434	9.370	0.000	Supported and significant
SCDC → SCREL	H10	0.447	7.758	0.000	Supported and significant
SCDC → SCC	H11	0.413	8.113	0.000	Supported and significant
SCDC → SCR	H12	0.223	4.219	0.000	Supported and significant
SCDC → CS	H13	0.238	3.928	0.000	Supported and significant
SCDC → SCQ	H14	0.111	1.944	0.053	Not supported and significant
SCDC → SCB	H15	0.510	11.008	0.000	Supported and significant
Note: $p < 0.05$					

Source: Author's own compilation.

As shown in Table 6.27, fifteen hypotheses were tested in total of which six were rejected for having p-values greater than 0.05 (H1, H3, H5, H6, H7 and H14) while 7 paths were highly significant (H8, H9, H10, H11, H12, H13 and H15) with p < 0.001 and 2 paths were significant (H2 & H4) with p < 0.05. Table 6.27 also reveals that GP, GM and LR had a negative and non significant effect on SCDC. Hypotheses results are discussed in the next section.

6.8.1.8 Discussion of the results of the study

This section discusses the results of hypothesis tests performed through data analysis to effectively address the empirical objectives presented and discussed in Chapter 1. Using Smart-PLS for the analysis, the study adopted two criteria under the SEM to evaluate (accept or reject) hypotheses. The first criterion requires the determination of the path coefficient represented by beta (β) of the relationship between latent and observed variables. The second criterion involves using the two-tailed statistical tests

(p-value and t-test) to demonstrate the level of significance of the path coefficients. P-values < 0.01 illustrate a high level of significance and p-values < 0.05 are characterised as significant. During the computation of the level of significance, any $p \leq 0.05$ and $t > 1.96$ illustrate the statistical significance of the hypothesis and therefore, the hypothesis is statistically significant and supported, otherwise it is deemed rejected and not supported.

Results of structural equation model analysis are presented in Table 6.26. As shown in Table 6.26, fifteen hypotheses were tested of which six were rejected for having a combined p-values greater than 0.05 and t-values less than 1.96 (H1, H3, H5, H6, H7 and H14) while 7 paths were highly significant (H8, H9, H10, H11, H12, H13 and H15) with $p < 0.001$ and 2 paths were significant (H2 & H4) with $p < 0.05$. Table 6.26 also reveals that GP, GM and LR have a negative and non significant effect on SCDC.

6.8.1.8.1 Results for hypothesis 1

The first hypothesis of the study (H1) suggested that there is a significant positive relationship between GP and SCDC. The path analysis results show that there is no relationship between these two constructs (β = - 0.004; t = 0.079; p = 0.937). The path coefficient was negative and very small (almost zero), indicating that GP has no influence on SCDC, the t-value was < 1.96 [the t-value should be greater than 1.96 to demonstrate the statistical significance of the path coefficient as recommended by Li *et al.* (2021)] and the p-value was higher than 0.05, which shows that the result is statistically insignificant. This result implies that the implementation of GP in the South African manufacturing sector has no influence on dynamic capabilities of any given firm. Therefore, H1 is not supported.

This result failed to confirm any support for the argument that GP has a positive relationship with SCDC. This suggests that despite the implementation of GP, it does not affect SCDC in any given firm in the South African manufacturing sector. The result contradicts a study by Kähkönen *et al.* (2018) in the Finnish manufacturing and logistics industry which found a positive association between GP and SCDC. In addition, Brandon-Jones and Knoppen (2018) used knowledge scanning as DC and found that strategic purchasing influences DC in the manufacturing and service industry in Europe and North America. However, the result of the present study corroborates the work of Abdallah and Al-Ghwayeen (2020) aimed at manufacturing companies in Jordan and found no relationship between GSCPs which included GP and business performance through a firm's internal operations.

The reason behind this unconventional result may be the cost associated with the implementation of green technology. This statement is consistent with AlNuaimi and Khan's (2019) argument which suggests that the implementation of GP comes with extremely complex challenges that include higher cost, lack of corporate commitment, insufficient knowledge, lack of alternatives and reluctance to change. Furthermore, Liu *et al.* (2015) point out that incorporating GP into a supply chain is a complicated process since it requires not only to consider traditional factors such as a supplier's cost, quality, lead time and flexibility, but also environmental responsibility. It is clear that South African manufacturers may have perceived that they do not possess the capabilities required to engage in sustainable activities. For example, a selection of suppliers may require sophisticated mechanisms that require well trained and qualified individuals to take on the evaluation process (Liu *et al*., 2015). Moreover, integrating suppliers into a supply chain requires exercises such as coaching, training and monitoring all of which consume considerable number of resources that often companies do not possess. Another possible explanation may have been that GP does not seem to be an issue for customers due to the lack of awareness on matters related to environmental sustainability.

6.8.1.8.2 Results for hypothesis 2

The second hypothesis (H2) of the study proposed that ED exerts a significant positive influence on SCDC. When examining the path and t-test analyses, one can see that ED was considerably and positively influencing SCDC with $\beta = 0.187$ and $t = 2.717$ at $p = 0.007$. The path coefficient scores indicates that ED has an impact on SCDC. Moreover, the *t*-statistic was found to exceed 1.96 and the *p*-value was lower than 0.05 indicating the significance of the results. This suggests that South African manufacturers perceived that ED has a positive effect on SCDC in their sector. Thus, the statistical evidence hereby suffices to support hypothesis H2.

The result of the study suggests that the implementation of ED in the South African manufacturing sector strengthens the ability of firms to innovate. This is in line with the results of a study by Hartmann and Germain (2015), targeting the Russian manufacturing sector which found that ecological product design (ED) relates positively to technology integration capabilities. Another study by Mahmud *et al.* (2020) conducted in the manufacturing sector in the United Kingdom revealed a positive and significant relationship between environmental management which included ED and product innovation through SCDC. Furthermore, a study by Bag *et al.* (2021) also suggested that ED is one the key resources for the adoption of the fourth industrial revolution innovation in the South African manufacturing sector as they provided evidence of a positive relationship between ED and innovative technologies.

Following the rationale of the RBV and DCV, Liu *et al.* (2018) postulate that the implementation of green strategies requires firms to possess appropriate resources and capabilities. This may suggest that South African manufacturers had aligned their organisational strategies in a way that fits their existing resources and capabilities and thus contributed to the successful adoption and implementation of green design strategies. As example, it is important to manufacturers such as Panasonic, Mazda and Nissan used ED as a value creating strategy through which they provide their know-how and expertise to the benefit of SCNs and to improve organisational performance (Liu *et al.,* 2018).

6.8.1.8.3 Results for hypothesis 3

The third hypothesis (H3) indicated that there is a significant and positive effect of GM on SCDC. The path examination demonstrates that there is insignificant and negative relationship between GM and SCDC (β = - 0.010; t = 0.143; p = 0.886). The beta was negative and closer to zero suggesting that GM does not affect SCDC while the t-value was less than 1.96 and the p-value greater than 0.05 suggesting that the relationship between the two variables is insignificant. This result implies that the GM does not improve SCDC in the South African manufacturing sector. This statistical evidence extends the support to disapprove hypothesis H3.

This lack of a relationship between GM and SCDC is surprising since this result is not consistent with extant literature which indicates that GM has a positive effect on SCDC. The result of the study indicates that GM is not related to SCDC thus, suggesting that the implementation of GM by South African manufacturers does not in any way impact SCDC. Prior studies evidenced a relationship between the two constructs for example, a study by Yusr *et al.* (2020) in the Malaysian manufacturing sector found a relationship between GSCM which included GM and innovative capabilities. Similar compatibility was provided by the work of Afum *et al.* (2021) in which it was reiterated that the adoption of green technology (GM) helps to achieve product innovation in the Ghanaian manufacturing sector. However, a study by Kofi Nkrumah *et al.* (2020), conducted in the manufacturing sector in Ghana is consistent with the result of the study. They found no relationship between GM and packaging and GSCM adoption (GSCM adoption in this context is grounded on green capabilities). This suggests that South African manufacturers were unable to incorporate green features in their products and services for a better environmental performance.

This result may be justified through the inability of South African manufacturing companies to establish collaborative mechanisms that promote cooperation and collaboration among supply chain partners in matters that advance innovation and green technologies. This outcome may also imply that manufacturers were unable to develop new competencies, redeploy resources and capabilities adequately for a sustainable competitive advantage. Furthermore, this result may suggest that the complexity associated with the implementation of GM. GM strategy involves complex techniques and systems that require the deployment of resources and appropriate capabilities (Liu *et al*., 2015). This was probably lacking for South African manufacturers.

6.8.1.8.4 Results for hypothesis 4

The fourth hypothesis (H4) suggested that GD exerts a significant positive influence on SCDC. The results in Table 6.26 indicate that indeed there is a significantly positive correlation between GD and SCDC ($\beta = 0.165$; $t = 3.114$; $p = 0.002$). The statistical scores of the path coefficient shows a positive relationship between GD and SCDC whereas the *t*-statistic ($t > 1.96$) and *p*-value demonstrate significance. This outcome indicates that the implementation of GD exhibits greater SCDC in the South African manufacturing sector. This outcome extends the support to approve hypothesis H4.

This result appears to suggest that GD benefited South African manufacturers by improving their organisational capabilities. This outcome complements the discourse of Subramanian and Abdulrahman, (2017) which concluded that carbon efficient practices which include transportation operations positively affect product redesign capabilities (DC) of manufacturing firms in China. Similarly, a study by Çankaya and Sezen (2019) emphasised on how GSCMPs which include GD positively influence environmental performance through strategic resources and capabilities in the Turkish manufacturing sector. Another study conducted by Novais *et al.* (2020) in Spain that involved 260 companies (the manufacturing was represented) found that cloud logistics which included transportation and distribution positively effects supply chain integration through SCDC. In this context, the implementation of such strategy has afforded South African manufacturers an opportunity to improve their competencies and promote technological innovation through GD.

This outcome may be a result of well-coordinated supply chain operations from up to downstream the supply chain using appropriate routing systems and technologies. Adequate coordination and cooperation among supply chain partners may have contributed to ease the timely response to customer demands as well as the distribution of products at correct quantities, scheduled time and right locations with minimum pollution of the environment. Moreover, the cooperation may have facilitated the improvement of supply chain capabilities for a better GD. Finally, manufacturers may have been able to integrate effective and efficient handling of supply chain resources to respond to customer's needs.

6.8.1.8.5 Results for hypothesis 5

The fifth hypothesis (H5) formulated suggested that RL exerts a significant positive influence on SCDC. The path analysis and *t*-statistics show that there is no significant positive relationship between RL and SCDC ($\beta = 0.071$; $t = 1.276$; $p = 0.202$). The path coefficient is closer to zero illustrating that RL does not influence SCDC. The computed *t*-value ($t = 1.276 < 1.96$) and *p*-value ($p > 0.05$) for the structural path coefficient demonstrate that the path coefficient is statistically insignificant. Thus, it is suggested that RL does not constitute an influential factor of SCDC in the South African manufacturing sector when implemented. This result does not confirm hypothesis H5.

The result indicates that RL did not have a relatively greater effect on SCDC in the South African manufacturing sector. This result does not espouse the work of Richey *et al.* (2005) which targeted the automobile aftermarket industry in the USA and found that committing resources on RL has a positive impact of the firm's ability to innovate. Additionally, Morgan *et al.* (2015) indicated that firms (including the manufacturing) in the USA that pay attention to their RL competency are more likely to achieve enhanced efficiency, effectiveness throughout their processes compared to those who forego RL. Bag and Gupta, (2019) also suggest that RL adoption positively influences remanufacturing operations performance in the automotive manufacturing in South Africa. A study by Agyabeng-Mensah and Tang (2021) indicated that green logistics practices have a direct significant positive influence on green competitiveness (green competitiveness depends on the resources and abilities of firms to support environmental sustainability) in manufacturing SMEs in Ghana.

A non-significant relationship between RL and SCDC may be due to the lack of utilisation of RL resources, competencies, collaboration with supply chain partners on strategic issues. It is important to point out that RL requires the exchange of goods and in this regard collaboration with the supply chain is essential. Moreover, this outcome may mean that RL decisions were not appropriately taken, resulting in increased cost and financial losses to manufacturers. It was important that South African manufacturers possessed competitive collaborative skills, build strong relationships with their suppliers and strategic partners and sought to develop and reconfigure their competencies in both information technology and RL.

6.8.1.8.6 Results for hypothesis 6

Hypothesis (H6) suggested that PR exerts a significant positive influence on supply chain dynamic capabilities. To examine the factor influencing PR with SCDC, the *t*-statistic and path analysis were performed, and the outcome demonstrates that there is no relationship between the two constructs ($\beta = 0.100$; $t = 1.715$; $p = 0.087$). The path coefficient score indicates that PR has no influence on SCDC while the *t*-value and *p*-value were not significant which demonstrate that South Africa manufacturers perceived that PR does not in any case affect SCDC in their sector and for any given company. This outcome contradicts H6 that was proposed in the study.

This result suggests that despite the implementation of PR strategy by South African manufacturers, they did not perceive any improvement in their ability to recapture value from returned products. It appears clear that the relationship between PR and SCDC stands in dissonance to previous works which suggest that there is an association between the two constructs. For example, the result of the study is contrary to that of Shaharudin *et al.* (2017) which suggested that PR promotes SCDC through closed loop supply chain in the Malaysian manufacturing. Another study by

Shaharudin *et al.* (2019) found a significant influence of PR on closed loop supply chain adoption capability under the lens of SCDC in the Malaysian manufacturing sector.

This outcome may have been the consequence of inadequate environmental guidelines not supportive of the PR strategy. It is important to point out that a poorly implemented PR strategy may hamper the prospect of green innovation through SCDC. South African manufacturers may have been unable to recognise the value associated with PR and develop systems and mechanisms that exploit returned products. Shaharudin *et al*. (2019) point out that the ability of a firm to recapture value from PR is of great importance since a failure to exploit product returns may lead to proliferation of industrial wastes and depletion of natural resources. It is important that South African manufacturers invest in remanufacturing capabilities to handle PR effectively since it could facilitate a leverage of their capabilities and help improve their competitive advantage.

6.8.1.8.7 Results for hypothesis 7

Hypothesis (H7) predicted in the study a positive effect of LR on SCDC. Table 6.26 provides the outcomes of the path analysis and *t*-statistic. The results show that LR do not have a positive and significant influence on SCDC (β = - 0.038; t = 1.276; p = 0.421). The path coefficient shows a negative prediction with a value which is almost null indicating no relationship between LR and SCDC. The empirical *t*-value was not larger than the recommended weight of 1.96 and *p*-value was greater than 0.05 suggesting that the path coefficient was insignificant. One can conclude that the South African manufacturing sector does not believe that the implementation of LR influences SCDC. Hence, hypothesis H7 was not confirmed.

The result of the study suggests that the ability of South African manufacturers to integrate government policies and regulatory requirements on green technology into their supply chains may not affect their ability to enhance competencies and innovate. This result contrasts the findings of a study by Fernando *et al.* (2018) conducted in the Malaysian manufacturing sector and involved 95 companies. Their results revealed a positive and significant relationship between RL and SCDC. While previous studies may suggest the role played by LR in improving SCDC (Zeng *et al.* 2017; Huang & Chen, 2021), the result of the study claims otherwise. Consistent with the outcome of the present study, the result of a study by Agarwal *et al.* (2018) showed that regulatory pressures do not have an influence on the adoption of green technologies for Midwest manufacturing companies in the United States of America. The study also revealed that market pressures do not significantly affect the adoption of green technologies.

One possible explanation may be that manufacturers may have felt that there are too many regulations that are difficult to comply with or the proposed LR does not target manufacturing companies specifically. Moreover, South African Government may have been less stringent regarding implementation of GSCM because of the lack of its financial support for businesses. Moreover, it may mean that manufacturers were not able to adjust their competencies and bring some effective changes to their processes as well as changes in their organisational culture.

6.8.1.8.8 Results for hypothesis 8

Hypothesis (H8) suggested a positive linkage between GT and SCDC. The path analysis indeed established a relationship between GT and SCDC through a positive and significant effect between the two constructs ($\beta = 0.286$; $t = 5.289$; $p = 0.000$). The path coefficient shows a positive value that demonstrates that GT positively impacts SCDC and a highly significant *t*-value ($t > 1.96$) and *p*-value ($p < 0.001$). This suggests that GT exerts a significant positive influence on SCDC in the South African manufacturing sector. Therefore, hypothesis H8 is supported.

This result is consistent with the findings of Aslam *et al.* (2019) in a survey targeting the Pakistani manufacturing sector in which a proposed relationship between GT through supply chain learning orientation and SCDC was supported. Similarly, Chen *et al.* (2019) in their study involving the logistics industry in Hong Kong also suggests that organisational learning contributes to provide great SCDC since firms have the opportunity to question their status quo and routine activities and enhance their ability to readjust their supply chain operations. Moreover, a study by Joshi and Dhar (2020), conducted in the handicraft industry (manufacturing) in India found a positive relationship between GT and SCDC.

The rational of this result may indicate that South African manufacturers supported the emergence of novel capabilities through their ability to change and abandon obsolete supply chain practices. Manufacturers may have committed sufficient resources to promote GT and creativity. These capabilities may have allowed employees to better match work with their particular strength (which environmental sustainability). GT is necessary to improve conditions for better SCDC through knowledge creation, skills and new capabilities. Aslam et al., (2019) postulate that learning is a fundamental part of a capability development in SCM that allows firms to tackle supply chain challenges and apprehend niche markets.

6.8.1.8.9 Results for hypothesis 9

Hypothesis (H9) indicated that SCDC exerts a significant positive influence on SCA. The outcome of the path analysis and *t*-test demonstrates effectively that SCDC has a positive and significant impact on SCA (β = 0.434; t = 9.370; p = 0.000). The path coefficient [β > 0.3 as recommended by Ahmadi-Azad *et al.* (2020)] showed a strong relationship between the two constructs and the *t*-value ($t > 1.96$) and *p*-value ($p < 0.001$) were also highly significant. This implies that SCDC had an impact on SCA in the South African manufacturing sector. Therefore, hypothesis H9 is supported.

The result of the study suggests that SCDC is more like to improve the agility of supply chains in the South African manufacturing sector. This result corroborates the findings of a study by Aslam *et al.* (2018) that found a positive relationship between SCDC and SCA in the manufacturing sector in Pakistan. Similar result was obtained in a study by Irfan *et al.* (2020) in the garment manufacturing industry in Pakistan. Moreover, Ramos *et al.* (2021) also found a positive relationship between SCDC and SCA in their study conducted in the Peruvian's Agri-industry.

The outcome of the study may be the result of improved efficiencies through SCDC within the South African manufacturing sector. Manufacturers may have been well prepared by developing structures, technologies and policies that allowed them to respond to customer demands with effectiveness and efficiency. In addition, manufacturers may have been able to respond timeously to market changes and seize opportunities by adapting their resources. Aslam *et al*. (2018) posit that firms with a well-developed SCDC are more likely to improve their SCA since managers have a better understanding of operations within the supply chains. The understanding of their processes may have effectively contributed to anticipate changes through the development of proactive strategies.

6.8.1.8.10 Results for hypothesis 10

Regarding hypothesis (H10) which suggested that SCDC exerts a significant positive influence on supply chain reliability, a positive and significant relationship was found between the two variables (β = 0.447; t = 7.758; p = 0.000). The path coefficient depicted a relationship between SCDC and SCREL while the t-value ($t > 1.96$) and p-value portrayed greater significance at $p < 0.001$. This suggest that it is perceived that SCDC contributed to improve the SCP of South African manufacturing firms through SCREL. Therefore, the path analysis result approves the evidence for supporting hypothesis H10.

The result of the study discloses that appropriate SCDC can improve the overall supply chain through reliability in the South African manufacturing sector. A study by Fernando *et al.* (2019) in the Malaysian service manufacturing found that SCDC improves the SCP through SCREL as well as other performance measures such as flexibility, responsiveness and customer's service. Another study by Geyi *et al.* (2020) investigated the effect of agile practices on sustainability performance measures in the UK manufacturing sector and found a positive association between SCDC and operational performance which included SCREL. This demonstrates the vital role played by SCDC in the manufacturing sector to improve the overall SCP through effective decisions taken timeously to reduce inefficiencies.

The rationale behind this result may have been that South African manufacturers were able to adhere strictly to customer requirements, deliver the correct products to their customers within the prescribed timeframe. Moreover, they may have been able to prepare, respond and recover from uncertainties such as the Covid-19 pandemic and maintain a steady state of operations in an acceptable time and cost. This assertion is supported by Geyi *et al*. (2020) who ascertain that firms that do not deliver products to their customers as per the established schedule, are likely to encroach on the trust and loyalty, thus resulting in reduced competitive advantage. Finally, South African manufacturers may have been able to eliminate in an effective ways non-value-added activities within their processes as well as supply chains.

6.8.1.8.11 Results for hypothesis 11

The eleventh hypothesis (H11) proposed a significant positive relationship between SCDC and SCC. The results of the path and t-statistics analyses illustrate a positive and significant link between SCDC and SCC (β = 0.413; t = 8.113; p = 0.000). The path coefficient shown an association between SCDC and SCC whereas the t-value (t > 1.96) and p-value (p < 0.001) were presented as highly significant indicating that SCDC enhanced the performance of South African manufacturers supply chains through cost reduction. The statistical evidence demonstrates that hypothesis H11 is confirmed.

This result is in line with a study by Brandon-Jones and Knoppen, (2018) conducted in the manufacturing and service industries in Europe and North America that found a positive relationship between SCDC and SCC. Similarly, a study by Singhry and Rahman (2019), targeting the Nigerian manufacturing sector used supply chain innovation capability under the lens of SCDC and found that there is a positive relationship between SCDC and SCP through SCC. Furthermore, a study by Lin *et al.* (2021), conducted in the US manufacturing and services industry suggested that SCDC enables product improvement through cost reduction, capital investment reduction and low business risks. This result demonstrates that SCDC have allowed South African manufacturers to effectively manage their labour costs, material costs, management and transportation costs, hence improving the overall cost of their supply chain. Jiang *et al*. (2015) postulate that firms that compete on cost have the ability to use their resources more efficiently and reap the benefits of low-price strategy.

South African manufacturers may have been able to design products and processes in a way that consumed fewer resources by enhancing efficiency. Moreover, they may have been able to effectively coordinate resources with their supply chain partners. This result may also demonstrate that manufacturers were able to refine their processes, create and innovate for better performance through cost efficiency.

6.8.1.8.12 Results for hypothesis 12

Hypothesis (H12) suggested that SCDC exerts a significant positive influence on SCR. The result shows that the path coefficient and t-value are consistent with the direction of the postulated relationship between SCDC and SCR and are highly significant at a conventional level (β = 0.223; t = 4.219; p = 0.000). The result of the path coefficient portrayed an association between the two constructs. The two-tailed tests (β > 1.96 & t < 0.001) illustrated high level of significance at 95% confidence. This result highlights the importance of SCDC by its t-value impact on SCR. Therefore, it is perceived that building organisational capabilities provided a better SCR in the South African manufacturing sector. Therefore, hypothesis H12 is supported.

This result extends to the work of Barau Singhry & Rahman (2017) targeting the Nigerian manufacturing sector that found a positive and significant relationship between SCDC and SCP through SCR. Similarly, the interconnectedness between entrepreneurial orientation as SCDC and SCR was also verified on the premise of a positive and significant path coefficient in a study by Luu (2017) in the chemical manufacturing industry in Vietnam. Similar result was generated through a study by Yu *et al.* (2019), conducted in the Chinese manufacturing sector. The study revealed the importance of strengthening capabilities through innovation to enhance SCR.

This outcome may have been a result of improved effectiveness of operational functions coupled with good coordination of supply chain resources. This may also imply that South African manufacturers demonstrated great level of flexibility and were able to quickly detect supply chain risks and take swift actions to mitigate these risks. It is relevant to point out that a real time exchange of relevant information between members can greatly improve the coordination process in the supply chain (Giannakis & Louis, 2016).

6.8.1.8.13 Results for hypothesis 13

Hypothesis H13 in the study advanced that SCDC has a significant positive influence on customer's satisfaction. The path examination was used to evaluate the hypothesised relationship between SCDC and CS. The results indicated that H13 had a positive path coefficient ($\beta = 0.238$), a *t*-value of $t = 3.928$ and was highly significant at $p = 0.000$. This suggests that the path coefficient is significant and therefore validates the hypothesis. The result is justified by the fact that it was perceived that companies that are innovative were more likely to witness the effect of SCDC on CS in the South African manufacturing sector. Therefore, hypothesis H13 was supported. This result corroborates the work of Sáenz *et al.* (2018) which concluded that manufacturing flexibility as SCDC contributes to improve CS in the Spanish manufacturing sector. Another study by Thekkoote (2021) modelling data-driven supply chain in the Indian manufacturing sector to evaluate its impact on supply chain performance and CS found that big data analytics supply chain (SCDC) has a positive influence on SCP through CS. Similar result was obtained in a study by Cuevas-

Vargas *et al.* (2022), targeting SMEs which included manufacturing firms in Colombia. The result indicated that the adoption of ICT significantly impacts CS.

Customers' experiences and perceptions are importance factors that add value to supply chain activities and production (Gligor *et al.*, 2020). One may stress that South African manufacturers may have aligned their efforts and developed capabilities with their supply chain partners to better meet the needs of customers. Thekkoote (2021) posits that companies need to focus on developing core skills and competencies that support building CS for the business in order to foster loyalty and improve the overall organisational performance. This may have been the case for South African manufacturers.

6.8.1.8.14 Results for hypothesis 14

With respect to hypothesis (H14) which postulated that SCDC is positively associated with SCQ, the result was not significant (β = 0.111; t = 1.944; p = 0.053). The path analysis through the *t*-test illustrated no significant level (t = 1.944 < 1.96 & p = 0.053 > 0.05). The result presented no influence of SCDC on SCQ, indicating that developing SCDC did not affect the quality of the supply chain in the South African manufacturing sector. This evidence does not support hypothesis H13.

This result is inconsistent with a study by Feng *et al.* (2017) conducted in the Chinese automotive manufacturing industry that found a positive relationship between SCDC and operational performance which included SCQ. However, this result is in line with a study by Huo *et al.* (2016) targeting the Australian manufacturing sector which found no relationship between external information integration under the lens of SCDC and quality. Another study by Yu *et al*. (2019) in the manufacturing sector in China produced similar result. The study shown that SCI under the lens of RBV does not affect operational performance through flexibility, delivery inventory cost and quality.

The possible explanation of this result is based on satisfaction theory. This may imply that when the level of expectation is too high, it might be difficult to achieve satisfaction in terms of quality (Huo *et al*., 2016). The South African manufacturing sector may have been faced with stiff international competition, as a result, it could not meet the requirements of customers resulting in very poor performance. It is relevant to point out that quality is of a great importance in supply chains since its integration promotes operational efficiency and CS which in turn results in competitive advantage (Li *et al.* 2019).

6.8.1.8.15 Results for hypothesis 15

As for the last hypothesis of the study (H15) which suggested that there is a significant positive relationship between SCDC and SCB, a path analysis and *t*-test results show that there is a relationship between these two constructs. The results are significant and demonstrate that SCDC has a positive effect on SCB ($\beta = 0.510$; $t = 11.008$; $p = 0.000$). The figures demonstrate that the path between the two construct was significant at $p < 0.001$. This shows the significant contribution of SCDC in improving SCB. Therefore, it can be inferred that SCDC influenced the SCB of companies in the South African manufacturing sector. As a result, hypothesis H15 is validated.

Consistent with this result, a study by Mandal *et al.* (2016) in the manufacturing sector in India found that logistics capabilities under the lens of SCDC helped develop supply chain collaborative measures among supply chain members that contributed to sustain operations in an uncertain environment. Similarly, Benzidia *et al.* (2021) found that internal integration which was considered as SCDC contributed to significantly improve collaborative behaviours resulting in knowledge sharing and process innovation between supply chain members in the French manufacturing sector.

One explanation of this outcome may have been the ability of South African manufacturers to develop supportive structures that facilitated the transfer of information, the exchange of knowledge and skills, the sharing of experience and technologies for a better and balanced performance. This structure may have allowed manufacturers to streamline their supply chain activities through improved efficiency. Another explanation may have been manufacturer's abilities to embrace strategic capabilities and dispatch measures to manage their supply chain networks in a way that enables more effective and sustainable approaches to respond to uncertainties and handle risks.

6.9 MEDIATION LINKS

A mediation occurs when a mediating variable intervenes between other related variables. This implies that a change in exogenous variable causes a change in the mediator variable, which in turn results in change in the endogenous variable in the path model (Hair Jr. *et al.*, 2021). Mediation analysis is important since it helps to determine the significance of the indirect effects that may exist between exogenous and endogenous constructs (Hair Jr. *et al*., 2017; Hair Jr. *et al*., 2021). In other words, an analysis may show that mediation does not exist at all or in a case of mediation effect, the mediator construct accounts either for some or for all of the observed relationship between two latent variables. For the current study, the mediation effects of SCDC were evaluated by examining the significance of the standardised indirect effects. If the indirect effect is significant, it means that the intervening variable which is referred as SCDC is completely mediating the relationship between GSCM practices and SCP in the South African manufacturing sector. Table 6.28 shows the mediation analysis of SCDC.

Table 6.28: Mediation analysis of SCDC

Relationship	Mediating Effect	T-value	P-value	Remark
GP -> SCDC -> SCA	-0.002	0.079	0.937	No mediation
GP -> SCDC -> SCC	-0.002	0.081	0.935	No mediation
GP -> SCDC -> SCB	-0.002	0.080	0.936	No mediation
GP -> SCDC -> CS	-0.001	0.079	0.937	No mediation
GP -> SCDC -> SCQ	0.000	0.070	0.945	No mediation
GP -> SCDC -> SCR	-0.001	0.079	0.937	No mediation
GP -> SCDC -> SCREL	-0.002	0.081	0.936	No mediation
ED -> SCDC -> SCC	0.077	2.279	0.023	Positive mediation
ED -> SCDC -> SCB	0.095	2.370	0.018	Positive mediation
ED -> SCDC -> SCA	0.081	2.417	0.016	Positive mediation
ED -> SCDC -> SCR	0.042	2.004	0.046	Positive mediation
ED -> SCDC -> SCREL	0.084	2.315	0.021	Positive mediation
ED -> SCDC -> SCQ	0.021	1.581	0.115	No mediation
ED -> SCDC -> CS	0.045	1.992	0.047	Positive mediation
GM -> SCDC -> SCA	-0.004	0.223	0.824	No mediation
GM -> SCDC -> SCB	-0.005	0.224	0.823	No mediation
GM -> SCDC -> SCQ	-0.001	0.188	0.851	No mediation
GM -> SCDC -> SCR	-0.002	0.215	0.829	No mediation
GM -> SCDC -> SCC	-0.004	0.225	0.822	No mediation
GM -> SCDC -> SCREL	-0.005	0.223	0.824	No mediation
GM -> SCDC -> CS	-0.002	0.214	0.830	No mediation

GD -> SCDC -> SCR	0.037	2.149	0.032	Positive mediation
GD -> SCDC -> SCQ	0.018	1.605	0.109	No mediation
GD -> SCDC -> SCC	0.068	2.632	0.009	Positive mediation
GD -> SCDC -> SCB	0.084	2.624	0.009	Positive mediation
GD -> SCDC -> SCA	0.072	2.625	0.009	Positive mediation
GD -> SCDC -> SCREL	0.074	2.608	0.009	Positive mediation
GD -> SCDC -> CS	0.039	2.127	0.034	Positive mediation
RL -> SCDC -> SCQ	0.008	0.696	0.487	No mediation
RL -> SCDC -> SCR	0.016	0.771	0.441	No mediation
RL -> SCDC -> CS	0.017	0.775	0.439	No mediation
RL -> SCDC -> SCC	0.029	0.819	0.413	No mediation
RL -> SCDC -> SCA	0.031	0.819	0.413	No mediation
RL -> SCDC -> SCB	0.036	0.817	0.414	No mediation
RL -> SCDC -> SCREL	0.032	0.815	0.415	No mediation
PR -> SCDC -> SCREL	0.045	1.566	0.118	No mediation
PR -> SCDC -> SCC	0.041	1.568	0.117	No mediation
PR -> SCDC -> SCA	0.043	1.479	0.140	No mediation
PR -> SCDC -> SCB	0.051	1.568	0.117	No mediation
PR -> SCDC -> SCQ	0.011	1.050	0.294	No mediation
PR -> SCDC -> SCR	0.022	1.491	0.137	No mediation
PR -> SCDC -> CS	0.024	1.355	0.176	No mediation
LR -> SCDC -> CS	-0.009	1.001	0.317	No mediation
LR -> SCDC -> SCA	-0.017	0.987	0.324	No mediation
LR -> SCDC -> SCB	-0.019	0.989	0.323	No mediation
LR -> SCDC -> SCC	-0.016	1.008	0.314	No mediation
LR -> SCDC -> SCQ	-0.004	0.818	0.414	No mediation
LR -> SCDC -> SCR	-0.009	0.936	0.350	No mediation
LR -> SCDC -> SCREL	-0.017	0.998	0.319	No mediation
GT -> SCDC -> SCREL	0.128	4.681	0.000	Positive mediation
GT -> SCDC -> CS	0.068	3.350	0.001	Positive mediation
GT -> SCDC -> SCC	0.118	4.544	0.000	Positive mediation
GT -> SCDC -> SCB	0.146	4.723	0.000	Positive mediation
GT -> SCDC -> SCA	0.124	4.370	0.000	Positive mediation
GT -> SCDC -> SCR	0.064	3.247	0.001	Positive mediation
GT -> SCDC -> SCQ	0.032	2.050	0.041	Positive mediation

Note: $p < 0.05$ indicates the significance
GP = Green Purchasing; **ED** = Eco-design; **GM** = Green Manufacturing; **GD** = Green Distribution; **RL** = Reverse Logistics; **PR** = Product Returns; **LR** = legislation and Regulations; **GT** = Green Training; **SCDC** = Supply Chain Dynamic Capabilities; **SCA** = Supply Chain Agility; **SCREL** = Supply Chain Reliability; **SCC** = Supply Chain Costs; **SCR** = Supply Chain Responsiveness; **CS** = Customer Satisfaction; **SCQ** = Supply Chain Quality; **SCB** = Supply Chain Balance.

Source: Author's own compilation.

As shown in Table 6.28, the results clearly indicate that SCDC did not act as a mediator between GP and SCP ($t < 1.96$; $p > 0.05$). For the paths ED to SCP, the indirect effect is insignificant ($t_{(SCQ)} < 1.96$; $p_{(SCQ)} > 0.05$) for ED and SCQ and significant ($t_{(remaining\ items)} > 1.96$; $p_{(remaining\ items)} < 0.05$) for the remaining items, thus indicating a partial mediation of SCDC in the relationship between ED and SCP. The causal analysis did not reveal any mediation effect of SCDC in the relationship between GM and SCP ($t < 1.96$; $p > 0.05$). Furthermore, the mediation test revealed an unsignificant indirect effect ($t_{(SCQ)} < 1.96$; $p_{(SCQ)} > 0.05$) for GD and SCQ and significant effects of SCDC ($t_{(remaining\ items)} > 1.96$); $p_{(remaining\ items)} < 0.05$) in the relationship between GD and the remaining dimensions of SCP, thus, suggesting a partial mediation of SCDC. No significant indirect effects ($t < 1.96$; $p > 0.05$) were found between RL and SCP suggesting that there was no mediation at all of SCDC between the two constructs. Similarly, for the paths PR to SCP through SCDC, the indirect effects ($t < 1.96$; $p > 0.05$) were not significant, stipulating no mediation effect of SCDC. Moreover, the relationship between LR and SCP through SCDC indicated no indirect effects ($t < 1.96$; $p > 0.05$), indicating no mediation of SCDC. However, for the relationship between GT and SCP, the indirect effects ($t > 1.96$; $p < 0.05$) were significant indicating full mediation of SCDC. It can be concluded that GT was the most important dimension of GSCM practices that contributed to enhance the performance of supply chains in the South African manufacturing sector through SCDC. ED and GD also played an important role in shaping SCDC for an improved SCP. Furthermore, the findings suggest that firms that are aiming to improve the performance of their supply chain networks and achieve competitive advantage must provide GT to their members, incorporate green strategies that include ED and GD and adopt SCDC regardless of its costs. SCDC will allow these companies to sense, seize and reconfigure their green strategies by rendering them more agile and resilient in order to improve the SCP and achieve competitive advantage.

6.10 LINK BETWEEN THE RESULTS OF THE STUDY AND THE THEORETICAL FRAMEWORK

This section discusses the linkage between the results generated by the study and the theoretical framework upon which the foundation of the current study is built. These theories were intensively discussed in Chapter 3 and included institutional theory (IT), dynamic capability theory (DCT) and contingency theory (CT). The three theoretical frameworks were explored by the researcher and found appropriate to provide strategic insights to practitioners on how to improve the level of competitiveness of their firms through the implementation of GSCM.

6.10.1 The link between the result of the study and institutional theory

Institutional theory outlines the role played by external and internal pressures on firms in shaping their strategies in a way that improves their competencies as well as their ability to innovate for a better organisational performance (Li *et al*., 2019). Choudhary and Sangwan (2019) and Kalyar *et al*. (2019) ascertain that IT is based on coercive isomorphism (pressures from governmental policies and customer expectations), normative isomorphism (originated from professional specifications and standards within a specific industry) and mimetic isomorphism (pressure to imitate the industry best practices in a time of uncertainty by remodelling business strategies).

Several authors reported the impact of institutional pressures on GSCM and SCDC (Garmann-Johnsen & Eikebrokk, 2017; Hidalgo-Peñate *et al*., 2019). Hypothesis tests of the study demonstrated that green practices such as ED, GD and GT exert an impact on SCDC in the South African manufacturing sector. These results are consistent with the essence of IT which stipulates that the pressures from government policies and regulatory guidelines on firms to adopt and implement environmental sustainability promote the development of new knowledge as well as competencies (Sheng, 2017). Similarly, Huang, Fang and Lin, (2019) argue that government policies and regulations influence the adoption of green technology. Through IT South African manufacturers illustrated how they perceived that the pressures from policies and regulations to implement ED, GD and GT have contributed to enhance their competencies and the ability to innovate in the green field. In line with assertion, Tooranloo *et al.*, (2017) advocate that the emergence of GSCM as well as institutional pressures have forced manufacturers to embrace environmental sustainability and foster the desire to innovate. The interaction between different stakeholders of a SCN contributes to create a conducive environment for innovations and compliance with LR (Seman *et al*., 2019). Even though some dimensions of GSCM which include GP, GM, RL, PR and LR did not show any effect on SCDC in the South African manufacturing sector, it is imperative for firms to follow the rules and guidelines established by various institutions and implement green strategies in order to improve their innovativeness and claim legitimacy within the society.

In addition, the study indicates that SCDC produces an effect on SCP through SCA, SCREL, SCC, SCR, CS and SCB. Younis and Sundarakani, (2019) postulate that firms are motivated by institutional pressures to pursue green strategy in an attempt to improve their SCP and achieve a sustainable competitive advantage. Resource based view under the impulse of regulatory practices suggests that information technology contributes to improve the SCP through innovation and creativity (Younis & Sundarakani, 2019). Scur *et al*. (2019) report that technology-forcing regulations play an important role in enhancing the adoption of eco-design technology for an improved SCP. However, no relationship was established between SCDC and SCQ in the study as a result of either inadequate regulatory pressures on manufacturers as discussed in previous sections or lack of financial support and coaching from the Government. Tumpa *et al.* (2019) posit that to encourage the adoption and implementation of GSCM, government policies must focus much its attention in developing incentive programmes rather than rules that dictate the course of actions. Since the political landscape of South African is plagued with ramping uncertainties, it would be beneficial for the South African Government to ramp up its effort in incentivising companies and encourage companies to adopt a mimetic approach which entails that during volatile situations, firms must rethink their processes, operations and strategies in order to enable them to seek for opportunities and ensure that their supply chain networks remain efficient and responsive to market demands.

These results suggest that indeed, there are institutional pressures that impact the adoption and implementation of GSCM, which further influence the performance of the supply chain in the South African manufacturing sector. In addition, the results demonstrate that regulation can influence decision making from the upper management within the South African manufacturing sector. The decision may involve the pursue of green technology, structural and organisational changes and so forth as manufacturers seek to achieve legitimacy of their operations in the view of all stakeholders in the marketplace.

In conclusion, the study suggests that its results corroborate the principles and foundation of IT which involve shaping organisational strategies in a way that improves competencies, incentivising manufacturing firms as well as promoting the ability to innovate for a better organisational performance. The results of the study suggest that green practices namely ED, GD and GT exert an impact on SCDC in the South African manufacturing sector while GP, GM, RL, PR and LR do not show any effect on SCDC. Furthermore, the study shows that SCDC produces an effect on SCP through SCA, SCREL, SCC, SCR, CS and SCB while no relationship is established between SCDC and SCQ.

6.10.2 The link between the result of the study and dynamic capability theory

Dynamic capability theory explains how firms can adjust and reinvent themselves to match the ever-changing needs of customers through technological innovation and development (Dias & Pereira, 2017). Furthermore, Gruchmann and Seuring (2018) allude that DCT is an extension of RBT which includes the ability to integrate, build and reconfigure internal and external competences to rapidly tackle the volatile and changing environment. This implies that DCT helps explore new opportunities, exploit inefficiencies within the supply chain networks and adapt business models for a better SCP.

The study established that ED, GD and GT exert an influence on SCDC in the South African manufacturing sector. This demonstrates the suitability of DCT in describing the experiences of South African manufacturers in the implementation of GSCM. As discussed in previous sections, the adoption and implementation of green practices by South African manufacturers triggered a change in status quo which resulted in new dynamics which included the reconfiguration of organisational resources, the development of innovative capabilities, the renewed organisational strategies and the development of new knowledge in response of market demands and increased level of competitiveness. This result corroborates the arguments of Hong *et al*. (2018) and Annunziata *et al.* (2018) which suggest that combining sustainable supply chain practices (SSCPs) such as GSCM practices with SCDC makes organisations more flexible to changes in a dynamic environment while providing at the same time a competitive advantage. Though, the study did not provide any evidence of a positive association between certain dimensions of green practices (GP, GM, RL, PR and LR) and SCDC and despite the recognised roles of GSCM in promoting green innovation, it is vital for manufacturers to implement green technology to improve their rate of survival in their sector.

Moreover, the study found that SCDC contributed to enhance the performance of the South African supply chain through SCA, SCREL, SCC, SCR, CS and SCB. This is in line with Kirci and Seifert's (2015) views which suggest that there is evidence of a positive relationship between SCDC and organisational performance. SCDC and SCQ did not show any link between the two constructs suggesting that South African manufacturers did not possess adequate resources and capabilities to achieve the performance required for a competitive advantage. Large organisations are likely to adopt green practices because they have sufficient and essential resources and capabilities than small organisations (Huang *et al.*, 2015; Huang *et al.* 2017). Liao *et al.* (2017) and Teece (2018) further argue that SCDCs need to be strong to influence organisational performance. This suggests that possessing SCDC is not enough to achieve an enhanced SCP. SCDC must be developed in areas of sensing, seizing and transforming and aligned with the overall organisational strategy in order to improve the SCP.

The results of the study demonstrate that DCT can shape, promote, and foster the development of green technology within South African manufacturing firms which in turn can translate to the improvement of the supply chains. Furthermore, the results indicate that DCT stimulates creative thinking which in turn contributes to create and add value for South African manufacturing firms especially in the wake of increasing competition within the manufacturing sector. The results also suggest that DCT allowed South African manufacturing firms to rapidly adapt to changes in the manufacturing sector by building, integrating, and reconfiguring their resources and capabilities.

Based on the aforementioned discussions, it can be concluded the results of the study are aligned with the essence of DCT which is to adapt, built, integrate and reconfigure resources for a better and improved supply chain performance. The results of the study reveal that ED, GD and GT exert an influence on SCDC in the South African manufacturing sector. In addition, study found that SCDC contributes to enhance the performance of the supply chain through SCA, SCREL, SCC, SCR, CS and SCB. However, the study did not provide evidence of a positive association between certain dimensions of green practices (GP, GM, RL, PR and LR) and SCDC; as well as between SCDC and SCQ.

6.10.3 The link between the result of the study and contingency theory

Contingency theory advocates that in times of uncertainty and economic turbulences, firms must embrace the best practices that can enable them to find the appropriate fit between their business strategies and their environment since there is no unique or exclusive way of applying the theory (Hallavo, 2015; Kros *et al.*, 2019). Yuen and Thai (2017) also suggest that CT does not support the principles of universality, it rather holds on to the adequate match between internal organisational structure and the external contextual factors which influence the performance of the firm. CT contributes towards the understanding of how internal competencies are deployed to provide strategic and situational responses to complexities and market uncertainties for an enhanced performance.

The relationship between green practices such as ED, GD, GT and SCDC was evidenced in the South African manufacturing sector. CT has allowed manufacturers to demonstrate their ability to meet the ever-changing needs of their customers through green products by developing countermeasures to mitigate risks associated with market uncertainties. It was also perceived that under the lens of CT, manufacturers were able to adapt their strategies and perform satisfactorily during the midst of the covid-19 pandemic. Recent development of the war between Russia and Ukraine is disrupting the global supply chain, this situation represents challenges for companies. They must find alternative means through CT to enable them to mitigate the risk of complete collapse of businesses and the economy as a whole. Zarei *et al.* (2019) indicate that contingency factors in market environments that are not controlled by a firm, dictate the course of actions to take in order to find adequate responses based on its internal resources and capabilities. However, no evidence of a positive influence of green practices which include GP, GM, RL, PR, LR and SCDC was found in the present study implying that CT did not impact the greening of the SC. Despite this lack of evidence, it is important to signal that successful companies cannot rest on their oars, they need continue to strive to sustain and improve their SCP.

Moreover, SCDC contributes to enhance the performance of the South African supply chain through SCA, SCREL, SCC, SCR, CS and SCB. This suggests that through CT manufacturers were able to maintain a good fit between their organisational structures and their business environment by strengthening their internal resources and capabilities through learning, technological innovation that enabled them to improve their SCP. This is consistent with the assertion by Smith *et al*. (2019) which indicates a firm that aligns its operations with its strategy is likely to witness a better SCP than a firm that does not. Furthermore, SCDC and SCQ were not linked as a result of inadequate fit between the firm's resources and capabilities and the market environment. This has resulted in poor performance and loss of competitiveness. It is vital for firms to integrate CT in their strategies since it enables the achievement of a sustainable improvement of the SC and enhanced competitive advantage in a hostile environment.

The results of the study indicate that CT provides a reliable basis for the study's theoretical framework. The adoption and implementation of GSCM is contingent upon deploying internal competencies to provide strategic and situational responses to complexities and market uncertainties for an enhanced performance. The results also show that CT is governed by two essential variables, namely: the firm-specific variable, which includes the ability of the firm to restructure, reorganise, adapt or develop new strategies, rapidly embracing technological development and train workforce to face new challenges; and the environmental variable, which results from the ever-changing market demands, the level of competitiveness, the technological uncertainty and the currency fluctuations, among others.

Given the above discussion, the study concludes that the results are in line with CT perspective which advocates that in times of uncertainties, firms must adopt the best practices in order to find appropriate fit between their business strategies and their environment since there is no unique or exclusive way of applying the theory. The results of the study suggest that the relationship between green practices such as ED, GD, GT and SCDC is evidenced in the South African manufacturing sector. However, no evidence of a positive influence of green practices which include GP, GM, RL, PR, LR and SCDC was found. Moreover, SCDC contributes to enhance the performance of the South African supply chain through SCA, SCREL, SCC, SCR, CS and SCB while SCDC and SCQ were not linked.

6.11 CHAPTER SUMMARY

The aim of this chapter was to present and discuss the research findings as well as provide insights on their interpretation. The chapter firstly presented a comprehensive summary of activities related to the data collection process followed by the pilot test results. The chapter further outlined descriptive statistics in which the response rate, sample size, profile of companies, demographic characteristics of respondents were discussed. The chapter also discussed the application of EFA for GSCMP and SCDC in which the actual correlations between items were presented. In do so, two new factors namely PR and CS were extracted deriving from RL and SCR respectively. The initial conceptual framework was then revised to incorporate the two new factors generated by the study and the descriptive statistics of all fifteen constructs was presented. Furthermore, the chapter provided the results of normality tests through skewness and kurtosis and discussed methods of reducing extreme values since the collected data were not normally distributed. After transformation of the skewness and kurtosis, the data followed a normal distribution pattern which prompted the use of Smart-PLS programme for the analysis.

Furthermore, the CMB result was presented and data were considered free from bias. The chapter also discussed the results of inferential statistics performed through PLS-SEM using Smart-PLS. The results of the measurement scale which included the reliability of each variable, the internal consistency (Cronbach's alpha and composite reliability), the construct validity, the convergent validity (average variance extracted – AVE) and the discriminant validity were presented. The results demonstrated that the measurement scale was valid and reliable. The model fit analysis was then illustrated through SRMR and NFI and was deemed meeting the requirements of the goodness of fit. In addition, the chapter outlined the results of hypothesis tests through which six hypotheses were rejected and included H1, H3, H5, H6, H7 and H14 while 9 others were supported namely H2, H4, H8, H9, H10, H11, H12, H13 and H15. Finally, the chapter linked the results of hypothesis tests to the theoretical framework that constitutes the foundation the current study. The next chapter discusses the conclusion and recommendations of the study.

CHAPTER 7

CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

7.1 INTRODUCTION

This chapter aims to provide a brief review of the seven chapters forming part of this thesis and suggest conclusions based on theoretical and empirical objectives. A research model for the relationships between GSCM practices, SCDCs and SCP in the manufacturing sector in South Africa is proposed. The model suggests that for a successful implementation of GSCM, green strategies should include ED, GD and GT since these dimensions contribute to develop and strengthen SCDCs through adaptative, absorptive and innovative capabilities. In addition, the ability of a manufacturing firm to develop SCDC produces a higher and better SCP through SCA, SCREL, SCC, SCR, CS and SCB. Furthermore, the chapter provides recommendations to practitioners based on the outcomes of the relationships between research constructs. It further provides a solid and unique evidence that supports the theoretical and practical contributions for supply chain professionals, scholars and policymakers. The chapter further delves into the inherent nature of limitations associated with the study. Finally, it suggests directions for future research with reference to the limitations of the study and closes with the chapter summary.

7.2 REVIEW OF THE STUDY

The objective of the study was to develop and test a conceptual model for the relationships between GSCM practices, SCDC and SCP in the South African manufacturing sector. The proposed model derived from three theories namely institutional theory, dynamic capability theory and contingency theory. The thesis is organised in seven chapters of which a review of each chapter is provided herein.

Chapter 1 introduced the manufacturing sector and provided the background of the study. The background looked at the importance of the manufacturing sector and its impact on the economy. In addition, the chapter highlighted the challenges faced by manufacturing companies on issues of environmental sustainability. The chapter further discussed the need to combine GSCM practices with SCDC for a higher SCP. Furthermore, the chapter provided a clear elaboration of the thesis statement, the problem statement which represents the cornerstone of this research project and the research questions. Moreover, the chapter presented the objectives of the study, the theoretical model, the theories that underpinned the study, a brief literature review of green practices, SCDC and SCP, the hypothesis statements and limitations and delimitation of the study. Furthermore, the chapter argued on the significance of the study and suggested brief methods that were applied to collect and analyse data. The chapter further discussed ethical considerations and offered definitions of terms as well as the research outline.

Chapter 2 involved the review of literature of the manufacturing sector in which the international and South African perspectives were discussed. Important developments in the manufacturing were provided as well as major industries within the manufacturing sector. With reference to the South African context, the institutional background of the manufacturing in the apartheid era was discussed as well as the periods pre and post democratic. Furthermore, the legislative framework for the South African manufacturing sector was presented, the contributions to the economy and the challenges faced by the manufacturing were also discussed with reference to economic, social, environmental, political and legislative aspects. The chapter also discussed the manufacturing sector in the context of environmental sustainability in which evidence of pollution across the South African manufacturing sector was provided. The chapter finally emphasised on the need for professionals to translate the theoretical knowledge provided as a sound resource for a successful implementation of GSCM practices in the manufacturing sector.

Chapter 3 analysed and discussed the literature review of GSCM practices. It started by introducing green practices and provided motivational arguments on the need to develop environmental sustainability as a result of increase pollution by manufacturing companies. A theoretical framework was presented in which institutional, dynamic capabilities and contingency theories were discussed as well as their importance in driving and fostering the implementation of GSCM. The chapter briefly presented the transition from SCM to GSCM and elaborated on the drivers of green practices. Furthermore, the chapter discussed the challenges that may obstruct the implementation of GSCM and provided some evidence of the importance of GSCM to stimulate its adoption and implementation for an improved efficiency, effectiveness and competitiveness in a business environment. The dimensions of GSCM practices which included GP, ED, GM, GD, RL, PR, LR and GT were also discussed. The chapter also provided a comprehensive view of a gap analysis based on previous studies conducted across the world and in South Africa in particular. The analysis stressed on the need to pursue the present study in order to develop a model of the implementation of GSCM that combines green practices, SCDC and SCP since the combination is still under researched in South Africa.

The fourth chapter provided an explanatory framework of GSCM and SCDC that translates to a higher SCP. The chapter described SCDC and provided some insights of its concepts and its ability to address organisational rigidity, sense, seize opportunities and adapt to market uncertainties. Moreover, a holistic assessment of intra- and inter-organisational activities was provided through SCP. This assessment ascertained that if organisational activities are managed and coordinated in a way that provides effectiveness and efficiency within the SCN, they can offer better benefits to supply chain members. The chapter also discussed each dimension of SCP which included SCA, SCREL, SCC, SCR, CS, SCQ and SCB that allowed the researcher to measure the effectiveness of supply chains in the South African manufacturing sector. The chapter further provided a conceptual framework that summarised the interrelationships between GSCM practices, SCDC and SCP. These relationships were discussed, and hypotheses developed.

Chapter 5 provided details of the research methodology used to investigate the effects of the relationships between GSCM, SCDC and SCP in the South African manufacturing sector. The chapter discussed the research reasoning which included inductive reasoning, deductive reasoning and abductive reasoning. The research paradigm was also discussed, followed by research approaches, research design, the time horizon and the collection of secondary data. Furthermore, empirical research approaches were presented in which sample design was discussed in detail, the data collection instrument was discussed as well as the data collection procedures. The procedures for data analysis which included data preparation, tests of data normality, descriptive statistics, inferential statistics, EFA and SEM were also presented. The chapter also discussed ethical considerations in which the respect of ethical and moral principles during and after the inquiry process were emphasised to ensure that respondents' integrity is preserved all the time.

The sixth chapter dealt with research findings. It presented a comprehensive summary of activities related to the data collection process, followed by the pilot test results. The chapter further outlined descriptive statistics in which the response rate, sample size, profile of companies, demographic characteristics of respondents were illustrated. The chapter also discussed the application of EFA for GSCM practices and SCDC in which the actual correlations between items were presented. The initial conceptual framework was revised to incorporate two new factors that were generated by the study and the descriptive statistics of all fifteen constructs was presented. Furthermore, the chapter provided the results of normality tests and discussed methods of reducing extreme values since the collected data were not normally distributed. The chapter also discussed inferential statistics results performed through PLS-SEM using Smart-PLS. The model fit analysis was illustrated through SRMR and NFI and was deemed meeting the requirements of the goodness of fit. In addition, the chapter outlined the results of hypothesis tests through which six hypotheses were rejected while 9 others were supported. Finally, the chapter linked the results of hypothesis tests to the theoretical framework that constituted the foundation of the present study.

Chapter 7 offers a review of chapters included in this thesis and provides various conclusions based on the theoretical objectives. These conclusions are related to the literature of the manufacturing sector in South Africa, research theories that help to better understand how to relate contextual conditions of constructs under consideration and GSCM, SCDC and SCP. In addition, the chapter lays out conclusions based on empirical objectives, and they mainly focus on respondent perceptions on the implementation of GSCM, the effectiveness of SCDC and the level of performance of the South African manufacturing sector. The chapter finally offers various recommendations, discuses the limitations of the study and suggests the need for future studies.

7.3 CONCLUSIONS BASED ON THEORETICAL OBJECTIVES

This section discusses conclusions that derived from the theoretical objectives set forward in Chapter 1. These objectives involved conducting a literature review of:

1) the manufacturing sector in South Africa
2) research theories and green supply chain management

3) Supply chain dynamic capabilities and supply chain performance

7.3.1 Conclusion on literature review of the manufacturing sector in South Africa.

The first theoretical objective was to conduct a literature review of the manufacturing with much emphasis on the manufacturing sector in South Africa. Despite the debate around the negative impact of manufacturing activities on the environment, it is clear that the manufacturing sector in South Africa represents an important pillar to stimulate the economic development. In South Africa, the manufacturing sector offers the highest potential to promote innovation, reduce widespread poverty, advance economic growth, create jobs for the working class and foster economic empowerment. Furthermore, the manufacturing sector contributes to 14 per cent of GDP and represents the fourth largest sector in the South African economic landscape. Moreover, it is important to point out that for every rand invested in the manufacturing sector, the South African fiscus gains 35 cents and R1.13 of output is generated, this demonstrates the pivotal role played by manufacturing companies. Given the propensity of the manufacturing to improve the lives of citizens, the South African Government must strive to improve the political landscape and restore investors' confidence in order to attract foreign investments and foster the economic development of the country.

7.3.2 Conclusion on literature review of the theoretical framework and green supply chain management.

This objective sought to provide conclusions on the literature review of the theoretical framework and that of GSCM.

7.3.2.1 Theoretical framework

Three research theories were considered in the study and included institutional theory, dynamic capability theory and contingency theory. The review of literature of these theories suggested that institutional theory is transferred to organisations through coercion, normative and mimic pressures. These pressures contribute to legitimise activities of manufacturing companies, promote innovation and improve the supply chain efficiency. Dynamic capability theory on the other hand describes the way in which manufacturing firms can adjust and reinvent themselves to match the ever-changing needs of customers through technological development and innovation. In addition, to improve their level of competitiveness, manufacturing firms need to build, adapt, refine and reconfigure their strategies in order to absorb the effects of constant changes in the marketplace. Moreover, the review of contingency theory suggested that the theory is governed by two essential variables, namely the firm-specific variable and environmental variable. The theory is recognised to facilitate better strategical, tactical and operational decisions that enable performance improvement in the supply chain networks which can ultimately lead to sustainable competitive advantage. Theories are essential ingredients to support, create and promote long-term innovative development within the South African manufacturing sector.

7.3.2.2 Green supply chain management

The review of literature indicated that the concept of GSCM was gaining strategic importance among practitioners as a result of growing issues related to climate change. GSCM contributes toward achieving economic, social and environmental performances. The literature review identified seven dimensions of GSCM practices namely GP; ED; GM; GD; RL; LR; and GT that were used to analyse and evaluate the implementation of GSCM in the manufacturing sector in South Africa. An additional dimension was extracted from RL and labelled PR. GSCM is recognised as an essential element needed to effectively compete in a dynamic environment where the life span of technological products is becoming shorter and shorter, and consumer needs more complex and sophisticated. Furthermore, it is recognised that green activities stimulate consumers' awareness on environmental issues, foster market penetration and expand market share for green products. The literature review reported that green products represent nowadays a marketing tool that can be used by companies to convey environmentally friendly characteristics of products to consumers. For the implementation of GSCM, it is important that manufacturing companies select the green practices that adequately fit their visions and strategies as well as their organisational structures.

7.3.3 Conclusions on literature review of supply chain dynamic capabilities and supply chain performance.

This objective focussed on providing conclusions on literature review of SCDCs and SCP.

7.3.3.1 Supply chain dynamics capabilities

Literature review suggested that DCs are characterised by their ability to address the rigidity of routine activities, sense and seize business opportunities, innovate and adapt to market conditions. It is important to point out that strong and reliable SCDCs are those that are able, in times of high level of competitiveness and sophistication of consumer needs, to respond rapidly and adequately to changes through innovative initiatives and adjusted business models. This is made evident by the ability of firms to innovate and foster new product development. SCDC is diverse in its concepts and measures, making it challenging to establish and adopt a common conceptual framework. The current study conceptualised SCDC as adaptative capability, which entails taking advantage of opportunities that may arise within the supply chains; absorptive capacity, which represents the ability of a firm to collaborate, integrate, coordinate and exploit information from business intelligence for commercial purpose; and innovative capability, which refers to the ability to generate new competencies resulting in new product development. Manufacturing companies need to endow themselves with suitable SCDCs that can enable them to compete and achieve a sustainable competitive advantage in a dynamic environment.

7.3.3.2 Supply chain performance

Supply chain performance was described as a systematic process of assessing supply chain activities to determine the level of effectiveness and efficiency. The review of literature indicated that a suitable assessment of supply chain processes and operations ensures a proper allocation of resources as well as adequate settings to attain long-term objectives. In addition, the literature suggested that there is no single or unique way of assessing SCP. Despite considerable efforts made by practitioners to propose various ways of measuring SCP, awareness needs to be enforced to create a balanced SCN that guarantees the interests of supply chain members and those of consumers. To effectively measure the performance of supply chains in the South African manufacturing sector, performance metrics which included SCA, SCREL, SCC, SCR, CS, SCQ and SCB were used. It is important to note that an effective evaluation of the supply chain may add value to the supply chains and help achieve organisational objectives by monitoring the effective deployment of resources across the SCN. The combination of these performance metrics provided essential criteria that allowed a better performance measurement of the manufacturing supply chains.

7.4 CONCLUSIONS BASED ON EMPIRICAL OBJECTIVES

As presented in Chapter 1, the following theoretical objectives were brought forward. These objectives sought to:

1) Explore the extent of the implementation of green supply chain management practices (GSCMPs) in the South African manufacturing sector.
2) Examine the effectiveness of supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
3) Measure the performance of the South African manufacturing sector supply chains.
4) Investigate the influence of green supply chain management practices (GSCMPs) on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
5) Evaluate the influence of supply chain dynamic capabilities (SCDCs) on supply chain performance (SCP) in the South African manufacturing sector.
6) Develop a research model for the implementation of green supply chain management practices (GSCMPs), supply chain dynamic capabilities (SCDCs) and supply chain performance (SCP) in the manufacturing sector.

7.4.1 Conclusion regarding the perceptions of supply chain, operations and quality professionals on the implementation of green supply chain management in the South African manufacturing sector.

The first empirical objective focussed on respondent (supply chain, operations and quality professionals) perceptions on the implementation of GSCM in the South African manufacturing sector in Gauteng, Free State, Mpumalanga and Limpopo. This objective was achieved through the analysis of mean scores, minimum and maximum scores and standard deviations of each construct which included GP, ED, GM, GD, RL, PR, LR and GT.

7.4.1.1 Conclusion on respondent perceptions on the extent of the implementation of green purchasing in the South African manufacturing sector.

An analysis of descriptive statistics through the mean and standard deviation showed that respondents were overwhelming inclined toward the implementation of GP. GP was perceived to promote better management of resources through cost saving, efficiency and long-term sustainability. This leads to the conclusion that South African manufacturers that participated in the study indicated that GP is an important tool that promotes and helps achieve procurement initiatives.

7.4.1.2 Conclusion on respondent perceptions on the extent of the implementation of eco-design in the South African manufacturing sector.

Most respondents agreed and perceived that ED was implemented in their respective organisations. ED was characterised as a strategy that allowed manufacturing firms to use resources more efficiently and reduce considerably the amount of waste for a better environmental performance. It is therefore suggested that South African manufacturers that participated in the study implemented ED and perceived it as an important activity that drives ecological objectives within their supply chains.

7.4.1.3 Conclusion on respondent perceptions on the extent of the implementation of green manufacturing in the South African manufacturing sector.

With regard to GM, a large majority of respondents believed that it helped their respective companies to save energy and resources as well as allowed them to manufacture products that meet environment standards. In addition, GM has allowed manufacturers to incorporate green features to their products which resulted in increased market share, higher social, economic and environmental performance. Thus, it is argued that South African manufacturing firms that participated in the study implemented ED strategy.

7.4.1.4 Conclusion on respondent perceptions on the extent of the implementation of green distribution in the South African manufacturing sector.

Green distribution was widely accepted by respondents as a strategy that allowed manufacturing companies to use resources more efficiently. Respondents perceived a decrease in environmental impact was a result of a better management of transportation fleets’ networks. In addition, respondents believed that GD was vital for their companies to improve supply chain efficiency in terms of energy consumption, effective routing systems and environmental damages through low levels of gas emissions. This evidence leads the study to conclude that there was a meaningful level of implementation of GD within South African manufacturing firms that participated in the study as it enabled to select effective routings and reduce the level of gas emissions.

7.4.1.5 Conclusion on respondent perceptions on the extent of the implementation of reverse logistics in the South African manufacturing sector.

Respondents agreed that RL was a constituent of sustainability that helped them to incorporate massive changes in their supply chains for a higher performance. They ascertained that RL allowed their companies to make tactical and strategic decisions as well as fostered cooperation among supply chain members for a better utilisation of resources within the network. It is important to point out that companies used RL to improve their profitability and corporate social image as well as to effectively respond to customer needs and demands. Based on this result, it is considered that RL was implemented within South African manufacturing firms that were involved in the study.

7.4.1.6 Conclusion on respondent perceptions on the extent of the implementation of product returns in the South African manufacturing sector.

Product returns represented a new factor generated from RL by the study. Respondents agreed and perceived that PR was an important measure of sustainable development. They indicated that South African manufacturing companies implemented PR programmes either for end-of-life products, repairs, or for remanufacturing. In addition, respondents confirmed that PR was paramount in their quest for customer satisfaction since it allowed their companies to develop sound return policies to mitigate customer purchasing risks and promote sales. It can be argued that such return policies promoted healthy relationships between their customers and their companies, hence improving customer satisfaction and providing economic benefits. The study therefore concludes that PR programmes were implemented by South African manufacturing firms that participated in the study.

7.4.1.7 Conclusion on respondent perceptions on the extent of the implementation of legislation and regulations in the South African manufacturing sector.

Respondents disagreed that their companies implemented LR since they did not perceive any compelling factors that forced them to align their organisational strategies with environmental requirements within their sector. This result leads the study to suggest that LR strategy was not implemented to the expected level by firms that were surveyed in the South African manufacturing sector.

7.4.1.8 Conclusion on respondent perceptions on the extent of the implementation of green training in the South African manufacturing sector.

Respondents agreed and confirmed that their respective organisations implemented GT with the aim to endow personnel with skills and competencies that primarily focussed on promoting the firm values and elevating interests on pollution matters. They further stressed that GT fostered their awareness on sustainability issues and improved their skills in green technologies which may facilitate the transition to more renewable energy and build a resilient SCN. This result illustrates that GT was implemented by South African manufacturing firms that were involved in the study.

7.4.2 Conclusion on respondent perceptions on the effectiveness of supply chain dynamic capabilities in the South African manufacturing sector

The second empirical objective was designed to determine the effectiveness of SCDC of the manufacturing sector in South Africa. Respondents perceived and affirmed that their organisations were endowed with the ability to reconfigure business models and develop innovative capabilities. They further stressed that SCDCs have contributed significantly to build a resilient SCN through the mitigation of risks as well as to foster the ability to rethink their strategies. Moreover, it was ascertained that knowledge represented a valuable resource to achieve a competitive advantage. Based on this assertion, the study concludes that South African manufacturers that participated in the study possessed effective SCDCs as they were able to improve their rate of survival through the ability to search and seize business opportunities.

7.4.3 Conclusions on respondent perceptions on the level of performance of supply chains in the South African manufacturing sector

The third empirical objective involved capturing the perceptions of respondents on the level of performance of supply chains in the South African manufacturing sector in Gauteng, Free State, Mpumalanga and Limpopo. This empirical objective was examined through the analysis of mean scores, minimum and maximum scores and standard deviations of each performance measurement metric namely SCA, SCREL, SCC, SCR, CS, SCQ and SCB.

7.4.3.1 Conclusion on respondent perceptions on the level of supply chain agility in the South African manufacturing sector

Respondents of the manufacturing sector in South Africa agreed and perceived that their supply chains were agile and able to respond timeously to customer requirements while withstanding risk of disruption. SCA is recognised as an important element of competitiveness that allowed manufacturers to successfully adapt their strategies and resources to the ever-changing needs of customers. This result leads to the conclusion that there was a high level of SCA within the South African manufacturing supply chains of firms that participated in the study.

7.4.3.2 Conclusion on respondent perceptions on the level of supply chain reliability in the South African manufacturing sector

A large majority of respondents agreed that their supply chains had high level of reliability since their respective organisations were able to meet customer requirements in terms of speed, quality and accuracy. Additionally, SCREL was viewed as an important instrument that serves in evaluating order fulfilments, percentage of orders delivered in full, timeliness of deliveries to customers, documentation accuracy and undamaged state of products. Therefore, the study concludes that supply chains were reliable as a result of a high standard of coordination and collaboration among supply chain partners within the South African manufacturing firms that participated in the study.

7.4.3.3 Conclusion on respondent perceptions on the level of supply chain costs in the South African manufacturing sector

Respondents revealed that manufacturing companies in South Africa were able to minimise their SCC as a result of increased level of competitiveness within the sector.

It can be argued that the increase in competitiveness has prompted companies to start competing on cost, efficiency and flexibility. Furthermore, it was perceived that strategic relationships and collaboration between supply chain partners played a vital role in driving down costs. The study therefore concludes that manufacturing firms that participated in the study in South Africa were able to contain their costs at a low level, resulting in spin offs such as price benefits in terms of material, processing and logistics costs.

7.4.3.4 Conclusion on respondent perceptions on the level of satisfaction of customers in the South African manufacturing sector

Customer satisfaction represents the new factor that was extracted from SCR by the study. Respondents of the South African manufacturing sector agreed and perceived that CS was a key element that fostered customer loyalty and increased sales. This places emphasis on the need for manufacturers to engage with customers to develop and create a long-term relationship as well as build a favourable reputation. Moreover, it is important to point out that service quality, trust and commitment, product quality and reliability contributed to foster CS. This result leads the study to conclude that CS was at an acceptable level within manufacturing firms that participated in the study.

7.4.3.5 Conclusion on respondent perceptions on the level of supply chain responsiveness in the South African manufacturing sector

Most respondents perceived and agreed that their respective organisations implemented SCR and were able to make timely decisions to effectively tackle supply chain uncertainties (delivery delays, unsatisfied customers and issues related to lead time) that constituted an obstacle for the prospect of their supply chains. Considering these developments, the study concludes that the supply chains of South African manufacturing firms that participated in the study were responsive enough to changes in the marketplace.

7.4.3.6 Conclusion on respondent perceptions on the level of supply chain quality in the South African manufacturing sector

A large proportion of respondents from the South African manufacturing sector agreed that the products that derived from their supply chains provided safety guarantee, attractiveness and environmentally friendly features. It is relevant to indicate that quality plays an important role in enforcing the credibility and image of a firm. These attributes place SCR at the forefront of competitiveness of any given firm. As such, the study concludes that South African manufacturing firms that participated in the study were able to produce goods and services of high quality in different stages of their operations and throughout the entire networks.

7.4.3.7 Conclusion on respondent perceptions on the level of supply chain balance in the South African manufacturing sector

Respondents suggested that manufacturing companies promoted an atmosphere that was conducive for collaboration and cooperation with suppliers while mitigating risks and opportunism. In addition, it was ascertained that coordination of resources and collaboration between supply chain partners contributed to enhance innovative capabilities. Furthermore, it was noted that the ability to share information with suppliers constituted an attribute that enabled South African manufacturers to adapt and synchronise resources within their operations. Therefore, the study concludes that the benefits and risks emanating from supply chain operations were shared among partners in the supply chains.

7.4.4 Conclusions on the influence of green supply chain management practices on supply chain dynamic capabilities in the South African manufacturing sector

The fourth empirical objective consisted of establishing the influence of GSCM practices on SCDCs in the manufacturing sector in South Africa. Green dimensions consisted of GP, ED, GM, GD, RL, PR (new factor), LR and GT. This objective was achieved through the evaluation of the path coefficients among these constructs based on the hypotheses stated.

7.4.4.1 Conclusion on the relationship between green purchasing and supply chain dynamic capabilities

Hypothesis H1 investigated the influence of GP on SCDCs in the South African manufacturing sector. The result of the analysis suggested that there is no significant positive relationship between GP and SCDCs. This implies that despite the implementation of GP in the South African manufacturing sector no effect was perceived whatsoever on dynamic capabilities for any given firm. The result contradicted that of Kähkönen *et al*. (2018) and Brandon-Jones and Knoppen (2018) who found a positive relationship between the two constructs. However, this outcome was confirmed in a study by Abdallah and Al-Ghwayeen (2020). This unconventional outcome leads to conclude that GP did not influence SCDCs in the manufacturing firms that participated in the study.

7.4.4.2 Conclusion on the relationship between eco-design and supply chain dynamic capabilities

Hypothesis H2 proposed that ED exerts a significant positive influence on SCDCs. The result of the study confirmed indeed that there is a significant relationship between the two constructs. The result indicated that the implementation of ED in the manufacturing sector in South Africa strengthened the ability of companies to innovate. This result corroborates that of Hartmann and Germain (2015) and Mahmud *et al*. (2020) who found that ED relates positively to technology integration capabilities (SCDCs). This prompted the study to conclude that ED was an enabler of SCDCs in the South African manufacturing sector for firms that participated in the study.

7.4.4.3 Conclusion on the relationship between green manufacturing and supply chain dynamic capabilities

The third hypothesis (H3) indicated that there is a significant and positive effect of GM on SCDCs. The study revealed that there is no relationship between GM and SCDCs in the manufacturing sector in South Africa. The unconfirmed relationship between the two constructs suggests that GM is not related to SCDCs, implying that the implementation of GM by South African manufacturers does not in any way impact SCDCs. Prior studies evidenced a relationship between the two constructs (Yusr *et al*., 2020; Afum *et al*., 2021). However, a study by Asamoah *et al.* (2020) showed no relationship between the two constructs. Based on this result, the study concludes that there was no relationship between GM and SCDCs in the supply chains of South African manufacturing firms that participated in the study.

7.4.4.4 Conclusion on the relationship between green distribution and supply chain dynamic capabilities

Hypothesis H4 suggested that GD exerts a significant positive influence on SCDCs. The outcome of this analysis indicated that the implementation of GD exhibits greater SCDCs in the South African manufacturing sector. This outcome leads the study to stress that adequate coordination and cooperation among supply chain partners contribute to ease the timely response to customer demands, the distribution of products at the correct quantities, scheduled time and right locations with minimum pollution of the environment. This result complements the discourse of Subramanian and Abdulrahman (2017) and Çankaya and Sezen (2019) which found a positive relationship between GD and SCDCs. Based on this result, the study can conclude that GD in the manufacturing firms that were involved in the study contributed to improve SCDCs.

7.4.4.5 Conclusion on the relationship between reverse logistics and supply chain dynamic capabilities

The structural path coefficient of Hypothesis H5 demonstrated that the path coefficient between RL and SCDCs is statistically insignificant. This outcome challenges the results of the works by Richey *et al*. (2005) and Morgan *et al*. (2015) which indicated that firms that pay attention to RL competency are more likely to achieve enhanced efficiency and effectiveness compared to those that forego RL. The insignificant relationship between RL and SCDCs prompts the study to suggest that RL did not constitute an influential factor on SCDCs in the supply chains of South African manufacturing firms that were involved in the study.

7.4.4.6 Conclusion on the relationship between product returns and supply chain dynamic capabilities

The path coefficient of hypothesis H6 indicated that PR has no influence on SCDC. This implies that despite the implementation of PR strategy by South African manufacturers, they did not perceive any improvement in their ability to recapture value from returned products. A poorly implemented PR strategy may have hampered the prospect of green innovation through SCDCs. This outcome is in dissonance to previous works that suggest an association between the two constructs (Shaharudin *et al*., 2017; Shaharudin *et al*., 2019). The result of the study demonstrates that South Africa manufacturers that participated in the study perceived that PR programmes had no impact on SCDCs for any particular firm.

7.4.4.7 Conclusion on the relationship between legislation and regulations and supply chain dynamic capabilities

The path coefficient of hypothesis H7 showed a negative prediction which indicates no relationship between LR and SCDCs. This result suggests that the ability of South African manufacturers to integrate government policies and regulatory requirements into their supply chains has not affected their ability to enhance competencies and innovate. This result is consistent with the finding of a study by Agarwal *et al*. (2018) which showed that regulatory pressures do not have an influence on the adoption of green technologies. Based on this assertion, the study concludes that the implementation of LR by participating manufacturing firms in the study did not affect SCDCs.

7.4.4.8 Conclusion on the relationship between green training and supply chain dynamic capabilities

The path analysis of hypothesis H8 established a relationship between GT and SCDCs through a positive and significant effect between the two constructs. This result is consistent with the findings by Aslam *et al*. (2019) and Chen *et al*. (2019) which found a positive relationship between GT and SCDCs. The rational of this result may indicate that South African manufacturers supported the emergence of novel capabilities through their ability to change and abandon obsolete supply chain practices. This result suggests that GT exerted a significant and positive influence on SCDCs in the South African manufacturing firms that participated in the study.

7.4.5 Conclusions on the influence of supply chain dynamic capabilities on supply chain performance in the South African manufacturing sector

The fifth empirical objective consisted of establishing the influence of SCDCs on SCP in the manufacturing sector in South Africa. The performance of the supply chain was measured in terms of SCA, SCREL, SCC, SCR, CS (new factor), SCQ and SCB. This objective was achieved through the evaluation of the path coefficients among these constructs based on the hypotheses stated.

7.4.5.1 Conclusion on the influence of supply chain dynamic capabilities on supply chain agility in the South African manufacturing sector

The path analysis of hypothesis H9 demonstrated that SCDCs have a positive and significant impact on SCA. This implies that SCDC contributes to improve SCA in the South African manufacturing sector. This result corroborates the findings of studies by Aslam *et al*. (2018) and Irfan *et al*. (2020) that found a positive relationship between SCDC and SCA. It is important to point out that firms with well-developed dynamic capabilities are highly likely to improve their SCA since managers have a better understanding of operations within the supply chains. Therefore, it is concluded that

SCDCs positively exerted an influence on SCA in the South African manufacturing firms that were involved in the study.

7.4.5.2 Conclusion on the influence of supply chain dynamic capabilities on supply chain reliability in the South African manufacturing sector

The path coefficient of hypothesis H10 depicted a positive relationship between SCDC and SCREL. A positive relationship implies that respondents perceived that SCDC contributed to improve the SCP of South African manufacturing firms. It is recognised that appropriate SCDC can improve the overall supply chain through reliability. Previous studies also found a positive relationship between SCDC and SCREL (Fernando *et al*., 2019; Geyi *et al*., 2020). Eliminating nonvalue added activities within the SCN contributes to enhance the effectiveness, efficiency and the reliability up and downstream the supply chain. Based on this assertion, the study discloses that appropriate SCDC improved the overall supply chain through the reliability for South African manufacturing firms that participated in the study.

7.4.5.3 Conclusion on the influence of supply chain dynamic capabilities on supply chain costs in the South African manufacturing sector

The results of the path analysis of hypothesis H11 illustrated a positive and significant link between SCDC and SCC. This result leads to suggest that SCDC has allowed South African manufacturers to effectively manage their labour costs, material costs, management and transportation costs, hence improving the overall cost structure within the supply chain. The result is consistent with the works by Brandon-Jones and Knoppen, (2018) and Singhry and Rahman (2019) who found a positive relationship between the two constructs. Given the significance of this result, the study concludes that SCDCs enhanced the performance of the supply chains through cost reduction of South African manufacturing firms that were involved in the study.

7.4.5.4 Conclusion on the influence of supply chain dynamic capabilities on supply chain responsiveness in the South African manufacturing sector

The result of the analysis of hypothesis H12 showed that the path coefficient was consistent with the direction of the postulated relationship between SCDCs and SCR. The path coefficient portrayed an association between the two constructs implying that building organisational capabilities provided a better SCR in the South African manufacturing sector. This result extends to the work of Barau *et al*. (2017) and Yu *et al*. (2019) who found a positive and significant relationship between SCDC and SCR. This outcome leads the study to deduce that effective SCDC contributed to enhance the responsiveness of the supply chains of manufacturing firms that participated in the study.

7.4.5.5 Conclusion on the influence of supply chain dynamic capabilities on customer satisfaction in the South African manufacturing sector

The path coefficient was significant and therefore validated hypothesis H13 which stipulated that SCDC has a positive association with CS. The outcome is justified by the fact that manufacturing companies that showed some ability to innovate were likely to witness the effect of capabilities on CS. This result corroborates the works by Sáenz *et al*. (2018) and Thekkoote (2021) which concluded that SCDC contributes to improve CS. This leads the study to conclude that focusing on developing core skills and competencies helped to build CS and foster customer loyalty within South African manufacturing firms that participated in the study.

7.4.5.6 Conclusion on the influence of supply chain dynamic capabilities on supply chain quality in the South African manufacturing sector

The path analysis of hypothesis H14 presented no influence of SCDC on SCQ. This outcome suggests that the development of SCDC did not affect the quality of the supply chain in the South African manufacturing sector. This result is in line with the studies by Huo *et al*. (2016) and Yu *et al.* (2019) who found no relationship between SCDC and quality. This illustration of non-significance prompts the study to deduce that developing core competencies and focusing on innovative capabilities did not necessary lead to higher SCQ for South African manufacturing firms that participated in the study.

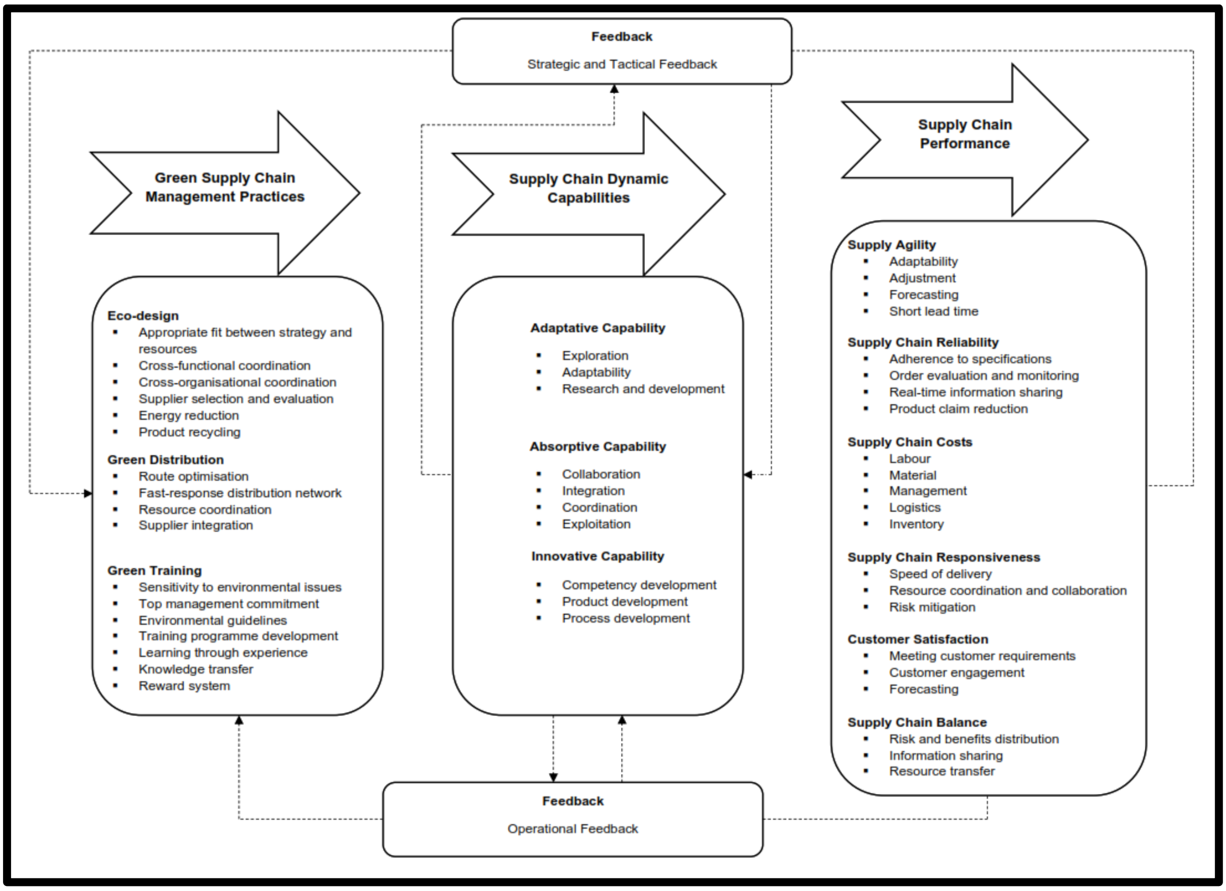
7.4.5.7 Conclusion on the influence of supply chain dynamic capabilities on supply chain balance in the South African manufacturing sector

The study revealed that there is a significant positive relationship between SCDC and SCB (H15). This result is supported by previous studies conducted by Mandal *et al*. (2016) and Benzidia *et al*. (2021) who found that SCDC helps to develop collaborative measures among supply chain members which in turn contribute to sustain operations in a dynamic environment. As a result of this assertion, the study infers that SCDC significantly influenced SCB in the South African manufacturing sector for firms that participated in the study.

7.4.6 Conclusion regarding the development of a model for the relationships between green supply chain management practices, supply chain dynamic capabilities and supply chain performance in the manufacturing sector in South Africa

The sixth objective was to develop a research model of the relationships between GSCM practices, SCDCs and SCP in the manufacturing sector in South Africa. This objective was achieved through the elimination of hypotheses that showed insignificant path coefficients and *p*-values. The path analysis results revealed that hypotheses H1(β = - 0.004; t = 0.079; p = 0.937), H3(β = - 0.010; t = 0.143; p = 0.886), H5(β = 0.071; t = 1.276; p = 0.202), H6(β = 0.100; t = 1.715; p = 0.087) and H7(β = - 0.038; t = 1.276; p = 0.421) did not demonstrate any statistical significance through the establishment of positive relationships with SCDC. This result leads to suggest that, despite the implementation of green strategies which included GP, GM, RL, PR and LR, South African manufacturers did not perceive any improvement in their ability to enhance their SCDC. In addition, the analysis also illustrated no relationship between SCDC and SCQ (H14 - β = 0.111; t = 1.944; p = 0.053). This result suggests that developing SCDC is not sufficient to improve the quality of the supply chain in the South African manufacturing sector. As a result of this statistical insignificance, all these hypotheses were discarded from the initial conceptual model to produce the model depicted in Figure 7.1.

Figure 7.1: Model of the relationships between green supply chain management practices, dynamic capabilities and supply chain performance in the South African manufacturing sector



Source: Author's own compilation.

Figure 7.1 represents the conceptual model developed as a result of the study. It is important to mention that the model derived from three theories, namely institutional theory, dynamic capability theory and contingency theory that helped to simplify the conceptualisation of GSCM practices for a sustainable competitive advantage.

Figure 7.1 shows only those measures that demonstrated a statistical significance as a result of the analysis. Based on these findings, the study suggests that for a successful implementation of GSCM, manufacturer green strategies should include ED, GD and GT since these dimensions contribute to foster the development of SCDC through adaptative, absorptive and innovative capabilities. In addition, the ability of a manufacturing firm to develop SCDC produces a higher and better SCP through SCA, SCREL, SCC, SCR, CS and SCB. It is important that these performance measures be adopted by manufacturers since they contribute to build a resilience, responsive and robust SCN for a sustainable competitive advantage. This view is premised by the positive and significant relationships between these constructs. Therefore, the study's suggested model postulates that:

- Eco-design (ED) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
- Green distribution (GD) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
- Green training (GT) exerts a positive influence on supply chain dynamic capabilities (SCDCs) in the South African manufacturing sector.
- Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain agility (SCA) in the South African manufacturing sector.
- Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain reliability (SCREL) in the South African manufacturing sector.
- Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain costs (SCCs) in the South African manufacturing sector.
- Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain responsiveness (SCR) in the South African manufacturing sector.
- Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on customer's satisfaction (CS) in the South African manufacturing sector.
- Supply chain dynamic capabilities (SCDCs) exert a significant positive influence on supply chain balance (SCB) in the South African manufacturing sector.

It is important to point out that the developed model also allows for feedback from SCP to SCDCs and GSCM practices or from SCDCs to GSCM practices. The feedback here represents an information channel that can facilitate strategic, tactical and operational decisions to attain the level of satisfaction and sustainability required to outperform rivals and achieve a sustainable competitive advantage. Strategic feedback can include but not limited to poor quality of products and services, environmental issues and non-application of industry standards. Tactical feedback can include lead time issues, competency issues, marketing related issues, suppliers not complying with the manufacturer requirements and purchasing of raw materials. Operational feedback can include issues related to day-to-day activities which consist of manufacturing, inventory, deliveries, transportation and on the job training. Feedback can be beneficial for both manufacturers and end users. This research model can facilitate both the implementation of GSCM and be beneficial for supply chain practitioners and scholars across the globe and in South Africa in particular.

7.5 RECOMMENDATIONS

A recommendation is defined as an advice, view or argument that is worthy of future considerations that scholars and practitioners can implement to achieve a specific goal (Costley *et al.*, 2019). Considering this definition, recommendations in this context can be described as logical extensions of discussions and conclusions regarding the implementation of GSCM practices in the South African manufacturing sector based on the evidence provided by the current study. The main purpose of recommendations is to identify potential areas of future improvement that scholars and practitioners can delve into based on the research findings. In other words, one can argue that recommendations provide some form of solutions to a specific problem discussed in a study or the directions for future research. The principal objective of the study was to develop a model for the relationships between GSCM practices, SCDC and SCP in the South African manufacturing sector. As a result of this exercise, the study suggests recommendations based on findings and conclusions of the study which may benefit supply chain practitioners and scholars or facilitate the implementation of GSCM in the manufacturing sector across the world and in South Africa in particular.

7.5.1 Recommendations on the relationship between green purchasing and supply chain dynamic capabilities

The result of the study suggests that the implementation of GP in the South African manufacturing sector has no influence on SCDC in any given firm. This outcome seems unconventional given the important role played by purchasing activities in gatekeeping sustainable procurement and controlling the environmental performance of suppliers. In support with this argument Bag *et al*. (2021) ascertain that strategic purchasing is a key resource that is vital in a quest for sustainability. Tapping into this will require manufacturers to leverage off these core areas:

Firstly, manufacturing companies should invest in GP (information technology and skill development). Investing in GP will require a management commitment as well as a cultural change within the organisation. Investing for instance in digital procurement will reinforce skill development through continuous education and training, promote buyer-supplier relationship and enable the availability of technologies that can be useful to supply timely information and optimise the procurement process. It is important that manufacturing companies strive to adapt their purchasing operations to innovation in the supply chain.

Secondly, manufacturers should design purchasing programmes that allow for a careful evaluation and selection of suppliers based on environmental requirements. Evaluating suppliers and setting environmental goals will help stimulate the development of evaluation capabilities through cooperation and collaboration. Moreover, the evaluation can create a sense of pressure of losing potential contracts, thus prompting suppliers to deploy resources that facilitate the compliance with the environmental standards they are subjected to.

Thirdly, manufacturers should provide designs that include environmental requirements to suppliers for purchased products and ensure compliance with the spelt specifications. It is also important to point out that the buyer-supplier purchasing relationship contributes towards designing environmentally friendly products and processes, operations and ensuring adequate coordination and resource allocation. GP may require developing new capabilities that can lead to the adjustment of processes in order to enable the exploitation and exploration of opportunities within the SCN.

Fourthly, manufacturers should require ISO 14000 certified suppliers or at a minimum, they should ensure that suppliers' quality management systems comply with environmental regulations. In addition, manufacturers should coach, train and monitor their suppliers as well as set environmental requirements for existing suppliers. At this stage, dealings should predominantly be enforced with suppliers that are ISO 1400 certified. Furthermore, manufacturers should also establish new partnerships with potential suppliers who can be able to meet their own green requirements and are taking environmental issues seriously.

7.5.2 Recommendations on the relationship between eco-design and supply chain dynamic capabilities

The result of the study suggests that South African manufacturers perceived that ED has a positive effect on SCDC in their sector. Thus, ED needs to be promoted within the South African manufacturing sector since it contributes to strengthen the ability to innovative. Developing a proactive implementation of ED strategy will require manufacturing companies to remain focussed on their objectives. It is therefore recommended that manufacturers undertake concrete actions on the following areas.

The first step should be to invest in various green design programmes and adopt organisational strategies that are aligned with their resources and capabilities. Achieving the required fit between strategies and capabilities may contribute to create value through which manufacturers will provide their know-how and expertise to the benefit of the SCN. Moreover, manufacturers should strive to improve internal coordination between functions and create synergies with common environmental goals as well as certain dedicated resources, efficient information management and effective training.

The second step should be for manufacturers to cooperate and collaborate with their suppliers to optimise both green production and environmental challenges. The engagement with supply chain partners in green design processes may help manufacturers to choose qualified suppliers for new design initiatives that are supported by a well-developed supplier selection and evaluation mechanism. In addition, this mechanism may enable manufacturers to introduce greener products rapidly and cost-effectively in the market. Furthermore, manufacturers should encourage and promote shared commitments and capabilities with suppliers.

The third step should be to create materials and components that are ecologically sound and competitive in the market with little effect on the environmental and measurable environmental quality. Such initiatives may develop manufacturers' specific competencies in areas of cross-functional and cross-organisational coordination and process improvement. In addition, manufacturers should develop products that facilitate remanufacturing, new product development and improvement and reduce energy consumption.

7.5.3 Recommendations on the relationship between green manufacturing and supply chain dynamic capabilities

Contrary to the study expectations, the finding yields that GM does not improve SCDC. GM represents a core function of green strategies as it incorporates product design, green technology and production and its practices are implemented throughout the products' life cycle (Belhadi *et al*., 2019). Given its importance, the following key recommendations highlight the areas in which South African manufacturers can improve their competences.

First, given the high cost associated with the implementation of GM, manufacturers should get the management buy-in, evaluate their investments and select practices that make business sense. They should develop proactive strategies that allow them to adjust their product designs for environmentally conscious markets. In addition, GM involves the manipulation of complex systems; therefore, manufacturers should strive to develop new competencies, redeploy resources and capabilities adequately for a sustainable competitive advantage. Furthermore, manufacturing should develop GM mechanism that facilitate the reconfiguration of internal and external competencies to achieve superior. For instance, the adoption of information technology capability may can serve as a lower-order capability that can be leveraged to develop a higher-order capability of GM effectiveness.

Second, manufacturers should establish collaborative mechanisms that promote cooperation among supply chain partners in matters that advance innovation and green technologies. Moreover, manufacturers and suppliers should effectively manage, coordinate resources and exchange creative ideas that are likely to generate green creativity resulting in new product development. Additionally, manufacturers should develop manufacturing flexibility that can allow them to produce a variety of products using for instance the same equipment.

Third, manufacturing companies should implement a total quality management and develop process designs that focus on reducing energy through energy efficient technology and consumption of natural resources in their operations. Manufacturers should substitute polluting and hazardous materials with environmentally friendly ones. Furthermore, manufacturers' production should optimise the exploitation of materials and they should filter and control their emissions and effluents.

7.5.4 Recommendations on the relationship between green distribution and supply chain dynamic capabilities

The outcome of the study indicates that the implementation of GD exhibits greater SCDC in the South African manufacturing sector. Manufacturing companies can sustain a positive and superior performance within their supply chains by leveraging competencies developed through GD. It is therefore important to promote GD in the South African manufacturing sector. Taking advantage of GD will require manufacturing firms to consider the following key recommendations.

First, manufacturing companies should develop competencies and capabilities that will allow them to improve their efficiency and effectiveness. For example, manufacturing companies can develop computation intelligence capabilities to optimise their routing systems and choose suitable distribution centres. Moreover, manufacturers should build a fast-response distribution network through information sharing and inter-organisational trust. They should consider building appropriate business models that include, teaming up with new partners or developing new strategic alliances with suppliers.

Second, manufacturers should develop well-coordinated operations from up to downstream of the supply chain using appropriate routing systems and technologies. In addition, manufacturers should ensure that information is readily available to all supply chain members in order to improve efficiency. An adequate coordination and cooperation among supply chain partners may speed up the time response to customer demands, provide goods at the correct quantities, avoid delays and supply products at the right locations with minimum pollution of the environment.

Third, manufacturers should also integrate effective and efficient handling of supply chain resources to better respond to customer's needs. In addition, they should optimise their operational processes to reduce waste in a way that controls their logistics operations.

7.5.5 Recommendations on the relationship between reverse logistics and supply chain dynamic capabilities

The result indicates that RL does not have a relatively greater effect on SCDC in the South African manufacturing sector. Considering the important role played by RL in enhancing competencies and reducing environmental pollution, actions are required in the following cross-cutting areas of strategic resonance.

Firstly, manufacturing companies should increase investments in RL and ensure these investments are aligned with the priorities set by the management. Their organisational culture and value should be ingrained in the personnel minds and spread across the entire supply chain to take investments to a higher level. In addition, manufacturers should commit resources and develop systems and technologies that improve the efficiency of logistics activities. Morgan *et al.* (2017) reveal that resource commitments may be used to develop a sustainable RL capability. Moreover, manufacturers should invest in technical expertise and integrate new processes of recycled products.

Secondly, manufacturers should develop RL competencies to transform return cost centre into profit maximisation centre. Competencies may arise from the reconfiguration and redeployment of existing resources. For example, firms such as Xerox, Canon, Estée Lauder, Caterpillar and Nike have successfully managed to create and redeploy their resources and capabilities to improve RL competencies for a better organisational performance (Morgan *et al.,* 2015).

Thirdly, manufacturing companies should maximise synergies to lower gas emissions from logistics activities. They should make joint decisions with their supply base on ways to reduce the overall environmental impact of logistics operations. Moreover, manufacturers should develop a value-seeking strategy to improve their corporate image. They should develop resource sharing capability and redesign existing supply chain processes.

Finally, manufacturers should enter strategic partnerships with suppliers since it constitutes a certain way to provide a unique service to end users that is difficult to replicate. They should establish a working relationship involving substantial knowledge sharing with their suppliers in the field of material recycling. Companies should optimise information sharing through the strategic use of information technology competencies that will allow supply chain partners to respond quickly to supply chain demands. In addition, manufacturers should work in concert with their partners to build collaboration and control mechanisms, develop new technical and operational knowledge to solve RL challenges.

7.5.6 Recommendations on the relationship between product returns and supply chain dynamic capabilities

The result suggests that despite the implementation of PR strategy by South African manufacturers, no improvement is perceived in the ability to recapture value from returned products. Evidence suggests that effective PR programmes stimulate innovative capabilities in sustainability which can help firms develop competencies and advance competitiveness (Shaharudin *et al*., 2018). Tapping into this will require manufacturers to leverage off these key recommendations:

First, manufacturers should develop adequate environmental guidelines supportive of PR strategy. A poorly implemented PR strategy may hamper the prospect of green innovation. In addition, manufacturers should be able to recognise the value associated with PR and adopt systems and mechanisms that exploit returned products. The ability to recapture value from PR is of great importance since a failure to exploit product returns may lead to proliferation of industrial wastes and depletion of natural resources (Shaharudin *et al*., 2019). Manufacturers should commit resources since they can play a critical role in leveraging financial performance.

Second, South African manufacturers should invest in remanufacturing capabilities to handle PR effectively since it could facilitate a leverage of their capabilities and help improve their competitive advantage. Moreover, manufacturers should focus on developing return competencies in a way that allows them to reap positive performance gains. A well-designed PR programme can become a source of competency. Manufacturers should have sufficient capacity to respond to the demands of returnable products and minimise wastes.

Third, manufacturers should establish effective collaboration and develop connections through information sharing and joint planning with their supply chain partners as evidence suggests that collaboration contribute to promote innovation and reduce cost. Companies should commit and support efficient product return programmes that involve sustainability to better handle recycled products and remanufacturing processes. An efficient management of PR can contribute to improve resource efficiency and provide some financial gains. Manufacturers should share information with their suppliers to adequately manage and optimise product returns.

Fourth, manufacturing companies should design adequate PR mechanisms that facilitate repairs and reuse of products with system integration. These mechanisms can ensure that products are recovered to save resources within the supply chain network. Moreover, manufacturers should carefully manage material reusability, energy quality and recyclability. For instance, manufacturing companies can manage their PR programmes in a way that prolongs the product life cycle and eases the reuse materials to minimise cost. This will guarantee the efficiency of resources and reduce emissions from production activities.

7.5.7 Recommendations on the relationship between legislation and regulations and supply chain dynamic capabilities

The study infers that the ability of South African manufacturers to integrate government policies and regulatory requirements on green technology does not affect their ability to enhance competencies and innovate. This result seems unconventional given the role of legislations in enforcing the adoption of green technology. Evidence suggests that LR practices influence the adoption and implementation of technology that minimises the effects of business operations on the environment (Huang *et al*., 2019; Scur *et al*., 2019). Martin and Bachrach (2018) also point out that the interaction between lawmakers and professionals provides companies with the ability to reconfigure their resources into a value-creating mechanism for a better performance. Achieving this will require manufacturers to consider the following recommendations:

Firstly, manufacturing companies should learn to deal with statutory requirements stemming from governmental institutions, industries and customers to bring about change and innovation within their supply chains. It is suggested that when companies are involved in institutional environment, they are motivated to adhere to rules, guidelines and values that contribute to shape their behaviours (Song & Zhao, 2020). In addition, manufacturing companies should develop a refined understanding of the role of government policies in promoting green initiatives. Adhering strictly to governmental legislations can allow companies to gain legitimacy and social acceptance.

Secondly, governments and institutional bodies should promote investments in research and development since leveraging capabilities is important for technological development. Ensuring compliance with statutory requirements can contribute to increase the propensity to adjust business models, organisational structure and engage in innovative practices, hence developing capabilities. These capabilities may allow manufacturers to explore and exploit opportunities that arise from the markets.

Thirdly, manufacturing companies should develop relationships with governments and state-owned enterprises to gain access to vital resources necessary to improve their competency and achieve better environmental outcomes. Governments should also implement mechanisms that compel companies to make necessary changes to their strategies to accommodate new capabilities to avoid potential penalties as a result of noncompliance with environmental requirements. In addition, governments should provide financial relieve to businesses in form of taxes, incentives and subsidies to encourage the adoption of green practices. These financial relieves can foster the adoption of even cheaper technologies that may help to control emissions from production activities.

Fourthly, state owned enterprises should facilitate the transfer of knowledge through training, information and technical expertise to businesses. For instance, in South Africa, small to medium enterprises (SMEs) can apply for coaching sessions to Small Enterprise Development Agency (SEDA) to endow them with managerial skills for an effective management of their businesses. Regulatory institutions should promote innovative collaboration within industries of the manufacturing sector. Government should support innovation by providing fundings, cooperative innovation platform and promoting technological innovation. Moreover, Government can provide resources and environmental support to manufacturers.

7.5.8 Recommendations on the relationship between green training and supply chain dynamic capabilities

This finding suggests that GT exerts a significant positive influence on SCDC in the South African manufacturing sector. It is important to point out that knowledge acquired through GT has emerged as a key resource needed to drive innovative development and create competitive advantage in businesses (Leal-Millán *et al.*

2015). Developing a knowledge driven organisation will require manufacturers to promote environmental learning in areas which include the followings:

First, the top management should develop sensitivity to environment issues within their organisations and that of the suppliers. The top management should craft and develop environmental targets, policies and guidelines that promote green initiatives as well as develop green capabilities. The top management should provide support and encourage green initiatives within its organisations since employees that are encouraged can become more involved in environmental matters. This involvement in green activities may result in green product innovation. Furthermore, top management should promote green value through training among employees and be transactional. For instance, the top management can implement a system that tracts and rewards employees for green creativity.

Second, manufacturing companies should develop their capabilities through investments in GT to enhance their ability to adapt to the changing business environment. Manufacturers should design training mechanisms that include learning through experience to support the development of competency. Learning through experiences facilitates the accumulation of knowledge which in turn stimulates the ability to resolve environmental challenges faced with ease and dedication (Tallott & Hilliard, 2016; Scholten *et al*., 2018). In addition, it can be pointed out that GT helps to generate new knowledge with the aim to improve both capabilities and organisational performance.

Third, manufacturing companies should design training programmes that are appropriate to their activities and foster awareness on ecological issues, promote personnel involvement in green initiatives and green creativity and serve as a motivating factor to advance green product development and build innovative capabilities. Moreover, manufacturers should develop GT programmes that help employees to perform their duties with confidence and reliability. These programmes should be designed in a way that helps employees to develop and build green culture which is a key capability designed to foster organisation as well as the efficient use of resources.

Fourth, manufacturing companies should go beyond their sphere of competencies and explore knowledge on environmental sustainability. Manufacturers should devote time, money and resources to build and develop collaborations mechanisms with supply chain partners that provide mutual benefits. Effective collaboration with suppliers can help build and establish a strong bond that is fundamental for innovation development. It is essential for manufacturers to spread green ideology within their supply chains. In addition, manufacturing companies should promote knowledge transfer with their supply chain partners since this initiative can foster information sharing and innovation for a better performance.

7.5.9 Recommendations on the relationship between supply chain dynamic capabilities and supply chain agility

The study suggests that SCDC improves the agility of supply chains in the South African manufacturing sector. This result highlights the important role that SCDC plays in enhancing operational performance through SCA. Being competitive requires manufacturing companies to concentrate their efforts on developing capabilities that can allow them to focus on areas of operational performance where SCA can be the most effective. Therefore, the study recommends the followings.

First, manufacturers should develop structures and policies that facilitate the response to customer demands with effectiveness and efficiency. These structures should enable manufacturers to make tactical and strategic decisions and spread these decisions across different hierarchical levels of the supply chain. In addition, manufacturers should put in place systems that enable timely responses to market changes and can allow to seize opportunities by adapting resources. Aslam *et al*. (2018) posit that firms with a well-developed SCDC are more likely to improve their SCA since managers have a better understanding of operations within the supply chains. It is important to point out that such capacity building may be the result of firm-specific assets which includes flexibility and information technology.

Second, manufacturing should develop a set of competencies through process excellence which include information technology and research and development to improve their operational performance through SCA. These competencies can allow manufacturers to rapidly respond to dynamics in the market to meet the demands of customers. Moreover, competency development can allow manufacturers to deal with supply chain uncertainties which include delivery delays, unsatisfied customers and extended lead time. Manufacturers should take significant actions to develop their capabilities and implement what they believe are the most advanced manufacturing tools based on the adaptability of their resources.

Third, manufacturers should work to increase agility within the entire supply chain and prevent risk of disruptions. They should enter strategic alliances with preferred suppliers as well as end users. The collaboration should be established upstream and downstream of the supply chain to facilitate the flow of information. Furthermore, manufacturers may also seek collaboration with their competitors for products they do not manufacture or services they do offer to add value to the entire supply chain process. Manufacturers should work in concert with their suppliers to bring lead time at its minimal and increase productivity.

Fourth, manufacturers should focus on promoting shared vision, technological integration and relationship development with their suppliers. This approach can lead to a better preparation in responding fast enough to customer ever-changing requirements. For instance, information technology if implemented can deliver electronic information to suppliers in real time, this can also contribute to improve speed, flexibility and responsiveness. Moreover, information technology can facilitate information sharing, communication and coordination in areas of high demand assessment, production scheduling and inventory monitoring and production quality.

7.5.10 Recommendations on the relationship between supply chain dynamic capabilities and supply chain reliability

The result of the study discloses that appropriate SCDCs can improve the overall supply chain through reliability in the South African manufacturing sector. Based on the significance of this result, the following recommendations may be able to assist manufacturers to better make decisions for the benefit of their supply chain.

First, manufacturers should establish collaborative systems with their suppliers that facilitate the coordination and control of products delivery to customers. Collaboration and cooperation can help manufacturers to leverage their resources and capabilities, resulting in higher performance. Moreover, manufacturers should put in place systems tract and evaluate orders that are fulfilled, the percentage of orders that are delivered in full, the time it takes to deliver to customers, the accuracy of the documentation and the conditions of products at the time delivery to customers. An effective tracking and monitoring of supply chain activities not only eliminates waste, but also enhances consistent goals and promotes collaboration and integration between businesses.

Second, manufacturers should develop a cloud platform for real-time information sharing. The cloud platform can facilitate a quick transfer of information and be integral part of the supply chain operations from upstream to downstream of the supply chain. For instance, manufacturers can use computer programmes such as enterprise resource planning (ERP) systems that can assist in accurately foreseeing and fulfilling unexpected demand. Information technology can help manufacturers make strategic decisions on sourcing and how to design an effective supply chain network. In addition, manufacturers should strive to reduce product failure rate by improving product reliability.

Third, manufacturers should ensure that they adhere strictly to customer requirements, deliver correct products to customers within the prescribed timeframe. They should also ensure that risks are mitigated in a way that provides firms' readiness to tackle supply chain issues. It is also suggested that firms that do not deliver products to their customers as per the established schedule, are likely to encroach on the trust and loyalty, resulting in reduced level of competitive advantage (Geyi *et al*., 2020). Manufacturers should be able to eliminate in an effective way all non-value-added activities within their supply chain processes.

7.5.11 Recommendations on the relationship between supply chain dynamic capabilities and supply chain costs

The study indicates that SCDC enhances the performance of South African manufacturers supply chains through cost reduction. This outcome seems conventional given the important role played by companies in curbing the cost of their operations. A successful implementation of a cost structure will require manufacturing companies to tap into the following three core areas.

First, manufacturers should design products and processes in a way that consumes less resources by ensuring proper coordination with customers, suppliers and partners. In order words, manufacturing should refine their processes and adopt innovative ways for a better operational performance through cost efficiency. Manufacturers should strive to adopt a low-cost strategy since the ability to use resources more efficiently provides price benefits. Having a low-cost structure can allow firms to provide their customers with better value for their money (Geyi *et al*., 2019). Managers of the supply chains should strive towards reducing labour, material and logistics costs. Jiang *et al*. (2015) postulate that firms that compete on cost can use their resources more efficiently and reap the benefits of the low-cost strategy.

Second, manufacturers should build information systems that integrate their suppliers, this can contribute to encourage cooperation between supply chain members. For instance, an integrated system such as ERP can facilitate the transfer of information and streamline the link between different members of the supply chains. Information technology integration can help separate the costs associated with different cost centres. This approach can provide manufacturers with the ability to reduce cost, create more value for customers and enjoy business superiority. In addition, integrating suppliers can allow manufacturing companies to build trust and promote knowledge transfer, joint learning and decision making, risk sharing and cost reduction associated with the exploitation and the exploration of resources.

Third, manufacturers should configure appropriate activity-based cost structure and develop capabilities that can allow them to reduce their inventory costs through accurately forecasting of market demands. Moreover, they should build information systems capabilities and develop closer relationships with their suppliers. An effective development of capabilities can contribute to a sustainable competitive advantage through cost reduction and elimination of non-added value activities. Manufacturing companies should invest in technological development since technology provides both quality and flexibility and reduces lead time and operation costs. Information technology can also help companies to identify and coordinate appropriate resources to improve capabilities and reduce costs.

7.5.12 Recommendations on the relationship between supply chain dynamic capabilities and supply chain responsiveness

The result of the study suggests that building organisational capabilities provides a better SCR in the South African manufacturing sector. Based on this outcome, the study recommends that the following areas be addressed by manufacturers.

First, the top management should provide its commitment for a better management of supply chain activities, develop sound organisational strategies, make use of adequate technologies and manage with effectiveness uncertainties. An effective coordination strategy can help in managing interdependencies among firms and reducing supply chain dynamics. In addition, manufacturers should invest in acquiring tools and platforms that are necessary to build their own electronic systems. They should develop operating procedures that promote flexibility, timely feedbacks, prompt decision-making, better and mutual understanding among supply chain members and fast and adequate response to customer needs and demands. Manufacturing companies should design systems that rapidly detect and react to supply chain risks and unexpected events within the supply chain. In addition, manufacturers should strive to improve their operational functions coupled with good coordination of resources. Moreover, manufacturing companies should demonstrate greater level of flexibility in responding to market demands.

Second, manufacturers should coordinate resources through real time exchange of information with their suppliers and partners. It is relevant to point out that real time exchange of relevant information between members can greatly improve the coordination process within the supply chain (Giannakis & Louis, 2016). Moreover, manufacturers should communicate with their suppliers in terms of actual orders received as well as define the amount of products required for their inventory. They should strive to speed up the delivery of products and services. Suppliers and manufacturers should share electronic data base to facilitate the centralisation of information. Supply chain members should share information about the location of shipments and the cycle time of a particular order. Furthermore, manufacturers should integrate the supplier information systems since it can lead to a better communication, effective information sharing and greater responsiveness at all stages of the supply chain that can result in shorter lead times.

Third, manufacturers should implement ERP and cloud systems to properly manage their resources and improve efficiency. These systems can allow manufacturers to request various services such as the acquisition of raw materials, quality inspections, product design, manufacturing requirements, production schedule and planning as well as the lifecycle management. Moreover, the systems can allow corrective actions to be taken timely to mitigate risks and avoid delays.

7.5.13 Recommendations on the relationship between supply chain dynamic capabilities and customer satisfaction

The result of the study suggests that companies that innovative witness the effect of SCDC on CS in the South African manufacturing sector. Thekkoote (2021) posits in order to be competitive, companies need to focus on developing core skills and competencies that support building CS. This can foster loyalty and improve the overall organisational performance. Given the importance of customers in improving the financial performance, it is recommended that manufacturers tap into the following areas.

First, manufacturers should seek commitment of the top management to drive and develop new ideas, validate them, assign and realign resources and develop new competences to match the evolving customer needs. In addition, manufacturing companies should focus on developing core skills required to support building CS. Capability development can ensure that all manufacturing efforts including those of suppliers and partners are designed to better meet the needs of customers.

Second, manufacturing companies should use digital technologies to help develop new business models that focus on creating value to customers. The use of new technology will require manufacturers to develop and build capabilities accordingly and promote effective communication between manufacturers and customers including prospective ones. In addition, the use of technology can facilitate the customisation of offerings and new products that are tailored to specific customer needs.

Third, manufacturers should acquire applications for internal management information systems such as Customer Relationship Management (CRM) to track not only sales but also promote customer participation in supply chain activities. Manufacturers and suppliers should identify, engage and interact with existing and prospective customers. Furthermore, manufacturing companies may also utilise Big data for business analysis and communicate decision-making and management operations to supply chain members. In addition, Big data analysis can ensure better information sharing, supply chain integration and coordination of resources that can lead to increased CS. Moreover, companies should work in concert with their supply chain partners to address market dynamism to better meet customer demands.

Finally, manufacturers should strive to forecast demands with precision and accuracy and reduce delays in shipments to enhance CS. They should also create a seamless experience with customers along different channels which include online and offline to improve their availability and willingness to solve customer issues. For instance, manufacturers can develop customer care lines to engage with customers or use social media such as Facebook, Instagram to help customers find specific solutions, products and brands, or connect with prospective customers. The utilisation these platforms can help increase brand awareness, attract customers and strengthen customer relationships.

7.5.14 Recommendations on the relationship between supply chain dynamic capabilities and supply chain quality

The result of the study shows no influence of SCDC on SCQ, indicating that developing SCDC does not affect the quality of the supply chain in the South African manufacturing sector. The result of the study seems unconventional given the importance of quality in enforcing the credibility and image of firms (Yu *et al*., 2017; Yu & Huo, 2018). Incorporating quality within a supply chain can help reduce quality control cost and improve overall operational and financial performances. In order to avoid issues of poor quality, manufacturing companies should address the following key points.

First, manufacturers should select suppliers that can meet their quality requirements. They should develop strategic partnerships with suppliers and provide them with technical expertise. Manufacturers should integrate their suppliers in order to foster the transfer of knowledge, information as well as resources to achieve high quality performance. It is important to note that information sharing can enable supply chain members to have a clear knowledge about the level of inventory and what customer orders. In addition, integrating suppliers can ensure that stocks are replenished in a timely manner and products are delivered to right customers. From integration perspective, programmes such as ERP can help manage data from different functions with accuracy and real time. Moreover, manufacturers should also implement big data analytic systems to obtain accurate predictions about the future needs of their production activities.

Second, stakeholders involved at different stages of the operations and throughout the entire SCN must ensure full compliance with the spelt specifications and standards. They should comply with the quantity of demands in terms of unit price and delivery schedule. Moreover, manufacturers should collaborate and coordinate processes with suppliers to help decrease costs through decreased inventory and shorter cycle times, improved quality and fast delivery. Planning with suppliers and partners can help manufacturers to manage inventory and avoiding overstocking or understocking products. Manufacturers should strive to always maintain stricter control for process quality and safety throughout the supply chain.

Third, manufacturing companies should maintain a high level of competency by strengthening strategies such as short lead time, just-in-time control, stock intake and quality management. They should continuously search for novel approaches to solving supply chain issues. Processes should be designed in a way that maintains consistency as well as the required standards. Companies participating in supply chain activities should leverage their innovative capabilities for the benefits of the supply chain. For example, manufacturers can develop absorption capabilities to enable them to continuously improve their products and processes. Manufacturers should understand the characteristics of their capabilities and use them to ensure product availability, maintain quality and consistency, on-time delivery and order fulfilment correctness.

7.5.15 Recommendations on the relationship between supply chain dynamic capabilities and supply chain Balance

The result of the study infers that SCDC influences the SCB of companies in the South African manufacturing sector. This result does not contradict the well-known role of SCDC in ensuring, integration, cooperation and risk sharing within the supply chain. Based on this outcome, the study recommends the followings.

First, manufacturers should enhance their capabilities and develop effective integrative mechanisms that allow joint decision-making, joint improvement programmes and joint research and development with suppliers and partners to create a more agile and balanced network. For instance, integrating information can allow manufacturers to synchronise and manage their processes with effectiveness. Furthermore, manufacturers should develop strategic alliances with suppliers and partners. The relationships with different stakeholders of the supply chain should be based on trust and should include the active participation of supply chain members in sharing resources, distributing risks and benefits. It is relevant to note that sharing risk and reward is essential to a successful collaboration.

Second, manufacturers should develop supportive structures that facilitates a transfer of information, exchange of knowledge and skills, experience sharing as well as technologies. This structure can allow manufacturers to streamline their supply chain activities through improved efficiency and effectiveness. Moreover, manufacturers should embrace strategic capabilities and dispatch measures to manage supply chain networks in a way that enables more effective and sustainable approaches to respond to uncertainties. Supply chain members should maintain a constant communication and keep each other informed about events or changes that may affect the other party.

Third, manufacturers should develop effective control mechanisms to tackle weaknesses, risks and vulnerabilities within the network. This approach can improve member capabilities and in turn lead to a more effective and balanced supply chain. It is important to point out that a balanced SCN can promote an atmosphere conducive for collaboration and cooperation while mitigating risks and opportunism simultaneously. In addition, manufacturers should ensure that practices within the network are standardised and adhered to by all supply chain members. Odongo *et al.,* (2017) ascertain that the standardisation of practices in the supply chain allows supply chain members to understand their roles and responsibilities, understand each other interests as well as their products and processes resulting in a more equilibrated and balanced supply chain.

7.6 CONTRIBUTIONS OF THE STUDY

This section discusses the contributions of the study to the body of knowledge in the field of SCM and involved theoretical, practical contributions as well as the implications for policymakers. The study provides a solid and unique evidence that supports the theoretical and practical contributions for supply chain professionals and policymakers.

7.6.1 Theoretical contributions

This piece of work contributes to the body of knowledge, innovation and organisational capability literature for the manufacturing by providing a comprehensive model for the relationships between GSCM practices, SCDCs and SCP. SCDC in the study mediates the relationships between GSCM practices and SCP. The study further shows the relevance of exploring competencies, exploiting opportunities and adapting business models to meet long-term objectives. In addition, the study provides new insights into the use of three theories that underpin this endeavour which include institutional theory, dynamic capability theory and contingency theory in a field of a study that is relatively at its infant stage in South Africa and in the manufacturing in particular. It is important to mention that although similar studies have been done before in the field of SCM, some substantial differences and gaps still exist, thereby providing an impetus to the present study.

While previous studies have mainly focussed on environmental and organisational performances through the implementation of GSCM (Namagembe *et al*., 2018; Seth *et al*., 2018), the current study provides empirical evidence of the relationships between GSCM, SCDC and SCP in the context of the South African manufacturing sector. The study uniquely explores the need of combining GSCM and SCDC to produce a sustainable competitive advantage. Moreover, the study illustrates that there is still a dearth of literature that links GSCM with SCDC and SCP. Thus, there is a need for further research studies based on empirical evidence to provide more insights into how GSCM and SCDC interact to produce a higher SCP.

7.6.2 Practical contributions

This research provides personnel involved in supply chain operations within the manufacturing sector with a clear vision and better understanding of the dynamics affecting the implementation of GSCM for a better SCP. The study encourages manufacturers to go green and seek commitment of the top management to invest both in sustainable practices and green technology, drive new ideas and validate them. The study also provides guidance and solutions to supply chain professionals regarding the management of sustainable practices as well as the development of innovative capabilities for a sustainable operational performance. The study is also important since it can help practitioners to recognise the need to better leverage operational capabilities such as agility and quality through the implementation of GSCM.

Furthermore, the results of the study provide managers with new perspectives on how to develop strategic alliances, collaborate and coordinate processes with supply chain members to satisfy customer requirements more effectively. It further demonstrates the need to develop core competencies that match the evolving business environment and capitalise on competitiveness through improved financial and environmental performances. Practitioners can benefit from the study by combining technology and competencies for a successful implementation of GSCM and maintaining a sustainable competitive advantage through new product development. Practitioners can now see the need of reducing their gas emissions to meet their green targets. Finally, the result of the study can help practitioners in raising awareness on the need to regularly review, monitor and control their supply chain processes to tackle risks and vulnerabilities.

7.6.3 Implications for policymakers

The outcome of the study also provides important guidance to policymakers. First, policymakers can now see the need to coordinate with manufacturers in order to develop business models that are inclusive of environmental requirements. Second, policymakers can also benefit from the study by recognising the need to encourage manufacturing companies to deal with statutory requirements to bring about change and innovation within their supply chains. Also, the results of the study can facilitate the development of mechanisms such as penalties or fines that compel manufacturing companies to make necessary changes to their strategies to accommodate new green capabilities to avoid potential penalties as a result of noncompliance with environmental requirements. Last but not least, policymakers can now see the need to provide financial relieve in form of taxes, incentives and subsidies to manufacturers to encourage them to adopt and implement sustainable practices.

7.7 LIMITATIONS OF THE STUDY

Despite the importance of the empirical results as well as the theoretical and practical contributions, the current study has some inherent limitations that future research can address. The study targeted specifically the manufacturing sector in a single country which is South Africa and was confined in four provinces which included, Gauteng, Mpumalanga, Free State and Limpopo. In addition, the population of interest consisted of individuals involved in supply chain activities which really limits the generalisation across the manufacturing sector in South Africa. Moreover, the results of the study apply only to the manufacturing sector in South Africa.

Furthermore, the sampling approach consisted of a non-probability sampling; therefore, the results of the study cannot be generalised across the South African manufacturing sector. In addition, a cross-sectional survey was administered making it difficult to evaluate the effect of the difference over the period in which the study was extended. Data were collected in three sets because Microsoft forms did not allow more than two hundred responses in a set. Moreover, the survey was a self-administered online questionnaire which required respondents to complete questionnaires on their own. Thus, respondents were susceptible to include bias by intentionally misrepresenting facts. However, the study ensured that technical terms were not used and respondents were asked to take their time when completing the survey to provide truthful and accurate responses. Moreover, the questionnaire provided options to respondents through a 5-point Likert scale, which did not compromise the integrity of responses. In addition, bias may have occurred as a result of some respondents not completing the survey (81 questionnaires were not returned out of 500). The study ensured that high level of responses by constantly sending a reminder to respondents. As a result, the overall response rate was at 80.40%.

Furthermore, the sampling design was also susceptible to include bias because respondents were assigned based on convenience sampling which lacked some degree of random criteria. This was addressed through criteria that consisted of selecting respondents based on their knowledge of SCM and that are involved in SC activities. In addition, the quota sampling technique was used since it possesses a unique sampling characteristic that can help eliminate distortions and improve the representativeness as well as the sample bias, especially because the validity was checked and confirmed.

Additional limitations include the absence of the moderating effect of a company size which defines the ability of a firm to embrace GSCM. It is important to note that the implementation of GSCM practices is dictated by the size of an organisation. This suggests that large organisations are likely to adopt sustainable practices than small organisations because they do possess sufficient resources and capabilities than small organisations. Considering the effect of these limitations, the study cautions readers to bear them in mind when interpreting the research findings.

7.8 SUGGESTIONS FOR FUTURE RESEARCH

The results provided by the study targeting only the South African manufacturing sector are not enough to explain the underlying effects of the relationships between variables of the proposed model. Therefore, it is recommended that future research explores other industries such as mining, construction among others within the South African context, or within the rest of Africa to further evaluate the proposed model and improve generalisability. In addition, since the study targeted only four provinces in South Africa, other provinces can be included in future studies to allow the generalisation of the findings. Further research could consider adopting a longitudinal research design since it may provide more information on the implementation of GSCM in the South African manufacturing sector and its relationships with SCDC and SCP. In addition, future research may also use secondary data. Futures research may consider mapping sample size against manufacturing sector contribution to the GDP for each country in which the study is conducted to bring greater insight into what a reasonable or sound sample size might be.

Moreover, future research could attempt to replicate the results of the study using a more diverse sample of respondents within the South African manufacturing sector. In addition, the model developed for the current study could be further extended in future research considering its implications for scholars and practitioners. Future studies could also delve deeper into exploring the conditions under which GSCM practices influence SCDC which in turn impact SCP. Future research could consider using other important variables other than that used in the study to evaluate the implementation of green practices and measure the performance of supply chains.

Furthermore, future research could consider the role of moderation such as company size in the implementation of GSCM to provide a sound and more comprehensive understanding of the relationships between variables of interest. In addition, future research could perhaps test the direct relationship between GSCM practices and SCP. The study was quantitative in nature, further research could adopt a qualitative or mixed approaches to provide a deeper and sound understanding on how GSCM interacts with SCDC to produce a higher performance. Moreover, future studies could use a probabilistic sampling technique instead of a non-probabilistic sampling design. Finally, given the propensity of the study to use a large sample size, this provided a basis for the relationships between GSCM, SCDC and SCP. GSCM is a highly dynamic area that continues evolve, evoking new concepts and patterns. Like any other sustainability concept, GSCM is also influenced by political, legal and technological factors that affect operational and strategic environments and markets. Future research should be geared towards addressing these dynamics by capturing the emerging concepts and trends. Thus, future research could also consider exploring these variables in conjunction rather than in isolation.

7.9 FINAL REMARKS

This chapter represents the final of the study; its aim was to provide recommendations to scholars and practitioners based on the research findings, as well as the limitations of the study and implications for future research. The study firstly provided a brief review of the entire study from Chapter 1 to Chapter 7 in which core developments are presented. The study also provided conclusions based on theoretical objectives in which conclusions on the literature of the manufacturing sector in South Africa, research theories and green supply chain management, supply chain dynamic capabilities and supply chain performance were provided. Moreover, conclusions based on empirical objections were also spelt. Empirical objectives mainly focussed on respondent perceptions on the implementation of GSCM practices which included GP, ED, GM, GD, RL, PR, LR and GT, on the effectiveness of SCDCs and on the level of performance of supply chains within the manufacturing sector in South Africa. In addition, the model of the proposed relationships was also presented. The chapter suggested various recommendations, indicated the limitations of the study and provided some directions for future research.

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7.11 APPENDICES

Appendix 1

Questionnaire Survey

SBL
GRADUATE SCHOOL OF
BUSINESS LEADERSHIP
UNISA

Project's Title
Modelling the Relationship Between Green Supply Chain Management Practices, Dynamic Capabilities and Supply Chain Performance in the South African Manufacturing Sector.
Confidentiality
Kindly note that this project is purely academic, and the data collected will be treated with discretion and will not be disclosed to the public or any other unauthorised
Duration to complete the Questionnaire
Please note that the questionnaire will take approximately 30 minutes to complete.
Timeframe
You are kindly required to submit your responses within two weeks of receipt of the questionnaire.
Communication
Researcher's name: Mr. Louis Roland Epoh. Contact number: (072) -145 6211. E-mail address: epohroland@hotmail.com/66101530@mylife.unisa.ac.za Research Supervisor's Name: Prof. C. Mafini. Contact details. Mobile: (083) – 642 9215 Work: (016) – 950 9520 E-mail address: chengedzaim@vut.ac.za

This questionnaire has been designed for the purpose of collecting data on Green Supply Chain Management Practices, Dynamic Capabilities and Supply Chain Performance in the South African Manufacturing Sector in Gauteng, Free State, Mpumalanga and Limpopo.

Should you have any inquiry to make on this survey, please feel free to contact the researcher.

Instructions: *You are kindly required to complete the questionnaire by placing "X" in the appropriate box.*

Please also take note that the researcher relies on your participation and inputs to complete the project.

Section A – Company profile

This section seeks to elicit information about the profile of your company. Please be reminded that the information provided will be treated with discretion and confidentiality. Additionally, your participation to the study is on a voluntary basis. This implies that you can withdraw from the survey at any time without any reprisals.

1- Position in your Company

Designation	Please choose	Designation	Please choose
Owner	1	Logistics Manager	8
General Manager	2	Operations Manager	9
Supply Chain Professional	3	Workshop Manager	10
Production Manager	4	Managing Director	11
Quality Controller	5	Other (please indicate)	12
Quality Engineer	6		
Quality Manager	7		

2- What is the industry classification of your Company? (Please choose)

Agro-processing and tobacco	1	Metals, fabricated metal products, machinery and equipment	6
Automotive	2	Textiles, clothing and footwear	7
Chemicals	3	Electrical machinery and apparatus	8
Information and communications technology	4	Wood products, paper and printing	9
Glass and non-metallic mineral products	5	Furniture and other manufacturing	10

3- Indicate your province (Please choose)

Gauteng	1	Free State	3
Mpumalanga	2	Limpopo	4

4- What is the number of employees in your Company? (Please choose)

Less than 20	1	101 to 200	4
21 to 50	2	201 to 300	5
51 to 100	3	Above 300	6

5- How long have you been working for this company? (Please choose)

Less than 2 years	1	11 to 15 years	4
2 to 5 years	2	16 to 20 years	5
6 to 10 years	3	Above 20 years	6

Section B - Demographic characteristics

This section seeks to elicit information related to your demography.

6- Indicate your Gender (Please choose)

Male	1	Female	2

7- Indicate your age group (please choose)

18 to 25	1	36 to 40	4
26 to 30	2	41 to 50	5
31 to 35	3	Above 50	6

8- Indicate your level of education (please choose)

Matric	1	Diploma	5
Degree	2	Post graduate diploma	6
Master	3	PhD	7
Professional Qualification	4	Other (please indicate)	8

9- Indicate your race (please choose)

African	1
Coloured	2
Indian	3
White	4
Other (Please indicate)	5

<u>Section C – Green Supply Chain Management Practices</u>

Please choose the extent to which Green Supply Chain Management practices are implemented in your company, using a Five-point scale anchored by: (1 - Strongly Disagree; 2 - Disagree; 3 - Neutral; 4 - Agree; 5 – Strongly Agree). Green practices consist of green purchase (GP), eco-design (ED), green manufacturing (GM), green distribution (GD), reverse logistics (RL), legislation and regulation (LR) and green training (GT).

Green Supply Chain Management Practices						
Green Purchasing						
GP1	Our company provides design specifications to suppliers that include environmental requirements for purchased items.	1	2	3	4	5
GP2	Our company performs environmental audits for suppliers' internal management.	1	2	3	4	5

GP3	Our company evaluates whether second-tier suppliers are using environmentally friendly practices.	1	2	3	4	5
GP4	Our company selects its suppliers based on environmental criteria.	1	2	3	4	5
GP5	Our company requires its suppliers to use environmentally friendly packaging (degradable and non-hazardous).	1	2	3	4	5
GP6	Our company requires suppliers to be certified ISO14000.	1	2	3	4	5
Eco-design						
ED1	Our company designs products in a way that reduces the consumption of materials/energy.	1	2	3	4	5
ED2	Our company designs products for reuse, recycle, recovery of materials and component parts.	1	2	3	4	5
ED3	Our company designs processes that minimise waste.	1	2	3	4	5
ED4	Our company designs products in a way that avoids or reduces the use of hazardous products.	1	2	3	4	5
ED5	Our company designs or redesigns products to reduce their overall environmental impact.	1	2	3	4	5
ED6	Our company reuses scraps and waste as inputs to saleable products.	1	2	3	4	5
Green Manufacturing						
GM1	Our company implements total quality environmental management.	1	2	3	4	5
GM2	Our company substitutes polluting and hazardous materials with environmentally friendly ones.	1	2	3	4	5
GM3	Our company filters and controls its emissions and effluents.	1	2	3	4	5
GM4	Our production planning and control focus on reducing waste and optimising the exploitation of materials.	1	2	3	4	5
GM5	Our process design focusses on reducing energy and consumption of natural resources in our operations.	1	2	3	4	5
Green Distribution						
GD1	Our company has optimised operational processes to reduce waste in a way that controls logistics operations.	1	2	3	4	5
GD2	Our company has improved on-time delivery rates in recent years.	1	2	3	4	5
GD3	Our company coordinates resources with its suppliers to achieve environmental goals.	1	2	3	4	5

GD4	Our company optimises effective routing systems to minimise travel distances.	1	2	3	4	5
GD5	Our company consolidates effective shipments and full vehicle loadings.	1	2	3	4	5
GD6	Our company selects cleaner transportation methods.	1	2	3	4	5
Reverse Logistics						
RL1	Our company is effective in handling product/service recalls.	1	2	3	4	5
RL2	Our company guarantees the quality of re-work and repairs.	1	2	3	4	5
RL3	Our company ensures completeness of re-work and repairs.	1	2	3	4	5
RL4	Our company ensures timeliness of re-work and repairs.	1	2	3	4	5
RL5	Our company accepts packaging that has been returned by customers.	1	2	3	4	5
RL6	Our company makes joint decisions with its supply base about ways to reduce overall environmental impact of logistics operations.	1	2	3	4	5
Legislation and Regulations						
LR1	Our company adopts green supply chain initiatives to avoid the threat of legislation.	1	2	3	4	5
LR2	Our company perceives environmental standards as difficult to comply with.	1	2	3	4	5
LR3	Our company is subjected to frequent government inspections.	1	2	3	4	5
LR4	Our company perceives that there are too many government environmental regulations.	1	2	3	4	5
LR5	Our company promotes customer awareness about environmentally friendly products.	1	2	3	4	5
LR6	Our company receives incentives from the Government (financial and non-financial).	1	2	3	4	5
Green Training						
GT1	Our company provides green education and training to employees.	1	2	3	4	5
GT2	Generally, our employees are satisfied with the green training offered.	1	2	3	4	5
GT3	The topics considered during green training are appropriate and current for company activities.	1	2	3	4	5
GT4	Formal environmental training programs are offered to employees in order to increase their promotional ability in the company.	1	2	3	4	5
GT5	Employees who receive green training have the opportunity to apply green knowledge in everyday activities.	1	2	3	4	5

Section D – Supply Chain Dynamic Capabilities

Please indicate appropriately how you rate the effectiveness of Supply Chain Dynamic Capabilities of your company, using a Five-point scale anchored by: (1 - Strongly Disagree; 2 - Disagree; 3 - Neutral; 4 - Agree; 5 – Strongly Agree).

Supply chain Dynamic Capabilities						
SCDC1	Our company has been able to stimulate knowledge acquisition and absorptive capacity.	1	2	3	4	5
SCDC2	Our company has a market-oriented perception ability.	1	2	3	4	5
SCDC3	Our company has developed innovation abilities.	1	2	3	4	5
SCDC4	Our company has an internal reconstruction ability.	1	2	3	4	5
SCDC5	Our company has built a social network relationship ability.	1	2	3	4	5

Section E –Supply chain performance

Please indicate appropriately how you rate the performance of your supply chain, using a Five-point scale anchored by: (1 - Strongly Disagree; 2 - Disagree; 3 - Neutral; 4 - Agree; 5 – Strongly Agree).

Supply Chain Performance						
Supply Chain Agility						
SCA1	Our supply chain can respond to changes in market demands without overstocks or lost sales.	1	2	3	4	5
SCA2	Our supply chain can leverage the competencies of our partners to respond to market demands.	1	2	3	4	5
SCA3	Our supply chain can forecast market demands.	1	2	3	4	5
SCA4	Our supply chain has reduced in-bound lead-times.	1	2	3	4	5
SCA5	Our supply chain ensures non-value-added time reductions in the pipeline.	1	2	3	4	5
Supply Chain Reliability						
SCREL1	Our supply chain system increases our order fill rate.	1	2	3	4	5
SCREL2	Our supply chain system increases our inventory turnover.	1	2	3	4	5
SCREL3	Our supply chain system reduces our safety stocks.	1	2	3	4	5
SCREL4	Our supply chain system reduces our product warranty claims.	1	2	3	4	5
SCREL5	Our supply chain system reduces our inventory obsolescence.	1	2	3	4	5
Supply Chain Costs						
SCC1	Our supply chain system reduces inbound and outbound costs.	1	2	3	4	5
SCC2	Our supply chain system reduces warehousing costs.	1	2	3	4	5
SCC3	Our supply chain system reduces inventory-holding costs.	1	2	3	4	5
SCC4	Our supply chain system reduces energy consumption costs.	1	2	3	4	5

SCC5	Our supply chain system reduces our product warranty claims.	1	2	3	4	5
Supply Chain Responsiveness						
SCR1	Our supply chain has short order fulfilment lead times.	1	2	3	4	5
SCR2	Our supply chain has short order-to-delivery cycle times.	1	2	3	4	5
SCR3	Our supply chain has fast customer response times.	1	2	3	4	5
SCR4	If a major competitor were to launch an intensive campaign targeted at our customers, our company would implement a response immediately.	1	2	3	4	5
SCR5	Our company is quick to respond to significant changes in our competitors' pricing structures.	1	2	3	4	5
SCR6	The relationships with our partners have increased our supply chain responsiveness to market changes through collaboration.	1	2	3	4	5
Supply Chain Quality						
SCQ1	Our final products conform to design specifications.	1	2	3	4	5
SCQ2	Our company ensures that its final products perform optimally.	1	2	3	4	5
SCQ3	Our company ensures on-time deliveries.	1	2	3	4	5
SCQ4	Our company provides accurate deliveries.	1	2	3	4	5
SCQ5	Our company is flexible in delivery times.	1	2	3	4	5
SCQ6	Our company always ensures speedy deliveries of its products.	1	2	3	4	5
Supply Chain Balance						
SCB1	Our company shares risks and rewards with its supply chain members.	1	2	3	4	5
SCB2	Our company shares research and development costs and results with its supply chain members.	1	2	3	4	5
SCB3	Our company has continual joint improvement programs with its key supply chain partners.	1	2	3	4	5
SCB4	Our relationships with key supply chain partners contribute to improve our manufacturing performance.	1	2	3	4	5
SCB5	There is an optimum exchange of information between our company and its supply chain members.	1	2	3	4	5
SCB6	Our company and its supply chain partners keep each other informed about events or changes that may affect the other party.	1	2	3	4	5

Section F –Further information

In the spaces below, feel free to add any additional information you would like to provide with regard to any of the statements mentioned above on Green Supply Chain Management Practices, Dynamic Capabilities and Supply Chain Performance.

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Thank you for taking your time to complete this questionnaire. Your views are much appreciated.

Appendix 2

Ethical Clearance Certificate

Graduate School of Business Leadership, University of South Africa, PO Box 392, Unisa, 0003, South Africa
Cnr Janadel and Alexandra Avenues, Midrand, 1685, Tel: +27 11 652 0000, Fax: +27 11 652 0299
E-mail: sbl@unisa.ac.za Website: www.unisa.ac.za/sbl

SCHOOL OF BUSINESS LEADERSHIP
RESEARCH ETHICS REVIEW COMMITTEE (GSBL CRERC)

05 March 2021

Ref #: 2020_SBL_DBL_035_FA
Name of applicant: Mr LR Epoh
Student #: 66101530

Dear Mr Epoh

Decision: Ethics Approval

Student: Mr LR Epoh, (epohroland@hotmail.com , 072 145 6211)

Supervisor: Prof C Mafini, (chengedzaim@vut.ac.za, 083 642 9215)

Project Title: Modelling the Relationship between Green Supply Chain Management Practices, Dynamic Capabilities and Supply Chain Performance in the South African Manufacturing sector.

Qualification: Doctor of Business Leadership (DBL)

Expiry Date: February 2023

Thank you for applying for research ethics clearance, SBL Research Ethics Review Committee reviewed your application in compliance with the Unisa Policy on Research Ethics.

Outcome of the SBL Research Committee:
Approval is granted for the duration of the Project

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the SBL Research Ethics Review Committee on the 03/03/2021.

The proposed research may now commence with the proviso that:

1) The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached
2) The researcher/s will ensure that the research project adheres to the values and

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Appendix 3

Respondent Information sheet

Graduate School of Business Leadership, University of South Africa PO Box 392 Unisa 0003 South Africa
Cnr Janadel & Alexandra Avenue Midrand 1685 Tel: +27 11 652 0000 Fax: +27 11 652 0299
Email: sbl@unisa.ac.za Website: www.sblunisa.ac.za

PARTICIPANT INFORMATION SHEET

28/09/2020

Title: Modelling the Relationship Between Green Supply Chain Management Practices, Dynamic Capabilities and Supply Chain Performance in the South African Manufacturing Sector.

Dear Prospective Participant,

My name is Louis Roland Epoh and I am doing research with Prof. Chengedzai Mafini, a Head of the Logistics Department at Vaal University of Technology. My study is being conducted in the Department of Management Systems towards a Doctor of Business Leadership (DBL) at the University of South Africa's School of Business Leadership.

The aim of the study is to model the relationship between green supply chain management practices, dynamic capabilities, and supply chain performance in the South African manufacturing sector. The study will entail collecting data from your company through a self-administered survey questionnaire. Information collected through the questionnaire will be subjected to statistical tests to determine the results.

The study will be beneficial in that its results will facilitate an understanding of the concepts of green supply chain management and promote the implementation of green practices. Moreover, it will help supply chain, operations and quality professionals to reconfigure their strategies in a way that improves the efficiency and effectiveness of their processes, enhances financial and environmental performances, and ensures long-term success.

Your company has been selected to participate in my study because firstly, it falls within the manufacturing sector and secondly, it deals with supply chain management (procurement of raw materials, manufacturing, and distributions).

Your role in this study requires completing a survey questionnaire which enquires about modelling the relationship between green supply chain management practices, dynamic capabilities and supply chain performance in the South African manufacturing sector. The questionnaire will be comprised of five sections, questions in Section C will be presented in the five-point Likert scales anchored by 1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly agree. The questionnaire consists of 85 questions that will require approximately 15-20 minutes to complete.

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Email: sbl@unisa.ac.za Website: www.sblunisa.ac.za

It is important to note that being in this study is voluntary and you are under no obligation to consent to participation. By filling the questionnaire, you will be given consent to take to the survey and you will be given this information sheet to keep as your reference. You are free to withdraw at any time and without giving a reason. But it will not be possible for you to withdraw once you have submitted the questionnaire to the principal researcher. There is no penalty or loss of benefit for non-participation.

You will not benefit directly from your participation in this research. You will receive no payment or reward, financial or otherwise. The results of the research will, however, be of scientific and practical value in understanding how the adoption of green supply chain practices may lead to long-term success of your organisation.

There are no foreseeable physical or psychological risks involved in participating in this study. The potential risk in conducting this study is that the time you may take to participate in the research project might be a cause of concern, since it requires between 15 and 20 minutes to complete the questionnaire. If you would like to discuss the research and your reactions to the questionnaires, you are welcome to do so after the session.

Any information obtained in connection with this study and that can identify you will remain confidential. Your name will not be recorded anywhere, and no one will be able to connect you to the answers you give. Your answers will be given a fictitious code number, or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

Your answers may be reviewed by people responsible for making sure that research is done properly, including a transcriber, external coder, and members of the Research Ethics Committee. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

The data collected may be used for research reports which include but may not be limited to journal articles, conference presentation, etc. Your privacy will be protected in any publication of the information. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

Hard copies of your answers will be destroyed by the researcher as soon as the information has been electronically captured and data analysis performed. Electronic information will be stored in a

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Cnr Janadel & Alexandra Avenue Midrand 1685 Tel: +27 11 652 0000 Fax: +27 11 652 0299
Email: sbl@unisa.ac.za Website: www.sblunisa.ac.za

password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies information with be destroyed by calcination on completion of the research project and electronic copies will be permanently erased from my computer hard drive.

This study has received written approval from the Research Ethics Committee of the College of Economic and Management Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

Should you wish to be informed of the final research findings, please contact Louis Roland Epoh on 072 145 6211 or epohroland@hotmail.com. The findings will be accessible end 2021.

Should you require any further information or want to contact the researcher about any aspect of this study, please contact Louis Roland Epoh on 072 145 6211 or epohroland@hotmail.com

Should you have concerns about the way in which the research has been conducted, you may contact Prof. Chengedzai Mafini of the Logistics Department at Vaal University of Technology; Mobile: 0836429215; Work: 01 6950 9520 or chengedzaim@vut.ac.za.

Thank you for taking time to read this information sheet and for participating in this study.

Louis Roland Epoh

Appendix 4

Non-disclosure Agreement Statistician

GRADUATE SCHOOL OF BUSINESS LEADERSHIP (SBL)

Confidentiality Agreement Template: Statistician

This is to certify that I, WV Loury-Okoumba, the statistician of the research project <insert title of the project> agree to the responsibilities of the statistical analysis of the data obtained from participants (and additional tasks the researcher(s) may require in my capacity as statistician).

I acknowledge that the research project is/are conducted by <insert name of researchers> of the Graduate School of Business Leadership (SBL), University of South Africa.

I understand that any information (written, verbal or any other form) obtained during the performance of my duties must remain confidential and in line with the UNISA Policy on Research Ethics.

This includes all information about participants, their employees/their employers/their organisation, as well as any other information.

I understand that any unauthorised release or carelessness in the handling of this confidential information is considered a breach of the duty to maintain confidentiality.

I further understand that any breach of the duty to maintain confidentiality could be grounds for immediate dismissal and/or possible liability in any legal action arising from such breach.

Full Name of Statistician: Welby Vandrys Loury Okoumba

Signature of Statistician: Date: 31 Jan 2021

Address of statistician Office E307. Faculty of Management Sciences. Andries Potgieter Boulevard. Vanderbijlpark. 1900

Statistical Company: VUT Faculty of Management Sciences

Any Job/reference number/ X001/2021

Full Name of Primary Researcher: _Louis Roland Epoh

Signature of Primary Researcher: ____ __________ Date: __25/12/2020____

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Appendix 5

Declaration of Editing

CERTIFICATE OF EDITING

I, C Vorster (ID: 710924 0034 084), Language editor and Translator and member of the South African Translators' Institute (SATI member number 1003172), herewith declare that I did the language editing of a thesis written by Mr. Louis Roland Epoh (66101530).

Title of the thesis: Modelling the relationship between Green Supply Chain Management Practices, Dynamic Capabilities and Supply Chain Performance in the South African Manufacturing Sector

5 October 2022

C Vorster	Date

Express Editing 24

Appendix 6

Turnitin Report

LR Epoh DBL Turnitin

ORIGINALITY REPORT

5%	4%	2%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Vaal University of Technology Student Paper	3%
2	digiresearch.vut.ac.za Internet Source	2%
3	pure.coventry.ac.uk Internet Source	1%

Exclude quotes On
Exclude bibliography On
Exclude matches < 1%