# A FRAMEWORK IN GREEN LOGISTICS FOR COMPANIES IN SOUTH AFRICA

by

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# DECLARATION

**STUDENT NUMBER: 51875160**

I declare that *A framework in green logistics for companies in South Africa*, is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE DATE

(Mrs)

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# ABSTRACT

Until recently, the concept of green logistics has been disregarded by various logistics and transport companies in South Africa. The study on which this dissertation is based explored the green logistics practices that these companies are currently implementing in terms of the key drivers, benefits and barriers. A quantitative research approach was followed, were a survey (Lime) served as the primary research instrument. A census was conducted among 160 companies in Gauteng. The results of the study revealed a significant difference between SMEs (<200) and large (200 and above) companies with regard to their importance rating on green logistics practices. To achieve the primary objective of the study, a framework in green logistics was drafted for SMEs and large companies in South Africa, which outlined practices and opportunities companies can implement in their own businesses to benefit from 'going green'. The usefulness of the latter mentioned guidelines needs to be tested in future research.

**Key terms:** Green logistics, Sustainability, Carbon footprint, Green supply chain management, Sustainable supply chain management, Environmental sustainability, SMEs, Triple bottom line

# TABLE OF CONTENTS

**CHAPTER 3**

**DRIVERS, BARRIERS AND BENEFITS OF GLOBAL GREEN LOGISTICS PRACTICES .................. 63**



**CHAPTER 4**

**RESEARCH DESIGN AND METHODOLOGY ............................................................... 88**

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF COMMONLY USED ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| **3Es** | – | environment, economic, ecological |
| **3Ps** | – | people, planet, profit |
| **APU** | – | auxiliary power unit |
| **AWS** | – | automatic warehousing systems |
| **BRICS** | – | Brazil, Russia, India, China, South Africa |
| **CEO** | – | chief executive officer |
| **CFO** | – | chief financial officer |
| **CLECAT** | – | European Association for Forwarding, Transport, Logistic and Customs services |
| **COO** | – | chief operating officer |
| **$CO_2$** | – | carbon dioxide |
| **CSCMP** | – | Council for Supply Chain Management Professionals |
| **CSIR** | – | Council for Scientific and Industrial Research |
| **CSR** | – | corporate social responsibility |
| **DC** | – | distribution centre |
| **DTD** | – | door to door |
| **EC** | – | European Commision |
| **EMS** | – | environmental management system |
| **EU** | – | European Union |
| **ERP** | – | enterprise resource planning |
| **GDP** | – | gross domestic product |
| **GLM** | – | green logistics management |
| **GSCM** | – | green supply chain management |
| **HR** | – | human resources |
| **IMS** | – | integrated management system |
| **ISO** | – | International Organisation for Standardisation |
| **IT** | – | information technology |
| **JIT** | – | just in time |
| **LED** | – | light-emitting diode |
| **$NO_2$** | – | nitrogen dioxide |
| **PLC** | – | provincial logistics capability |
| **USA** | – | United States of America |

| | | |
|---|---|---|
| **RF** | – | radio frequency |
| **RFID** | – | radio frequency identification |
| **ROI** | – | return on investment |
| **RSA** | – | Republic of South Africa |
| **SA** | – | South Africa |
| **SAIPA** | – | South African Institute of Professional Accountants |
| **SCM** | – | supply chain management |
| **SME** | – | small and medium enterprise |
| **SSCM** | – | sustainable supply chain management |
| **STATS SA** | – | Statistics South Africa |
| **TBL** | – | triple bottom line |
| **Tkm** | – | tonne-kilometre |
| **UK** | – | United Kingdom |
| **WCED** | – | World Commission on Environment and Development |

# CHAPTER 1

# INTRODUCTION TO THE STUDY

## 1.1 INTRODUCTION

Chapter 1 begins by providing an introduction and background to the study followed by an outline of the research problem, the research objectives, research methodology and finally the outline of the study. The chapter is discussed with reference to the flow diagram in Figure 1.1 below.

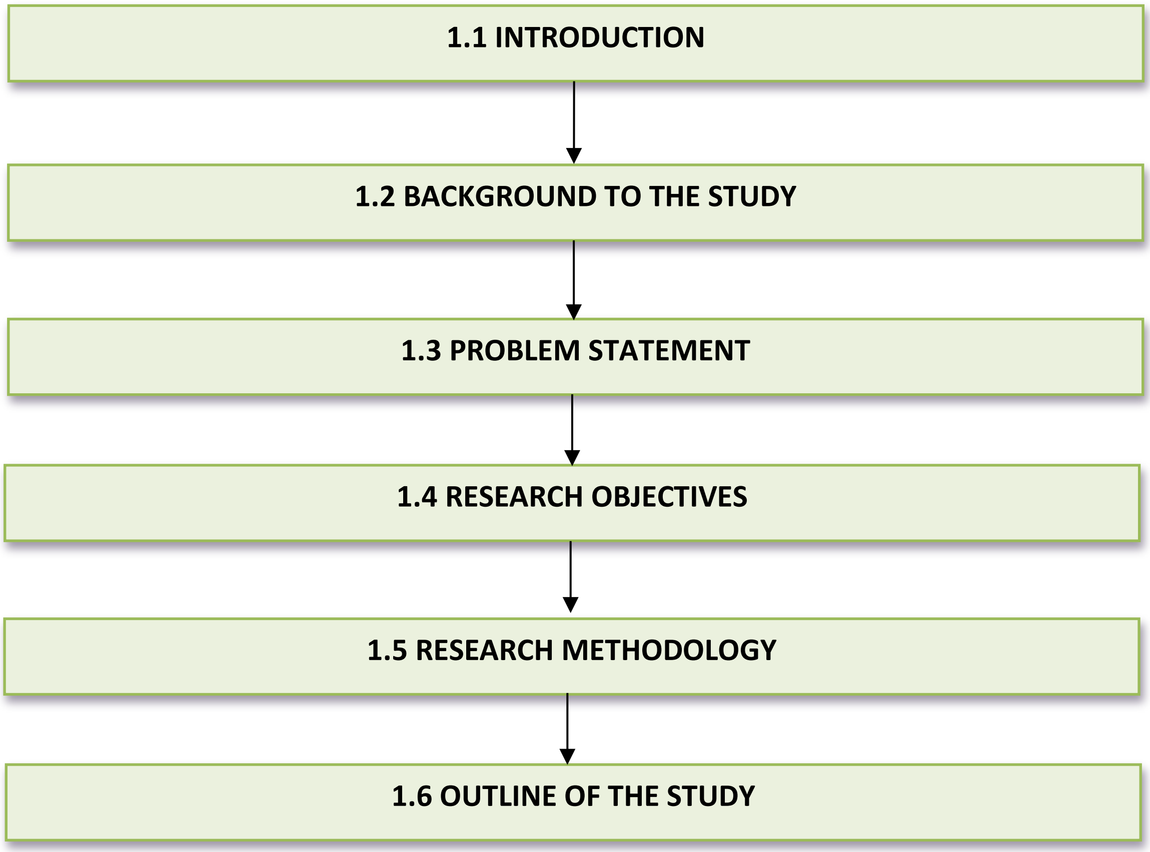


**Figure 1.1: Flow diagram of Chapter 1**

"Sustainability and environmental pollution are global concerns that affect both large and small firms in developed and developing countries" (Hsu, Tan, Zailani & Jayaraman, 2013:658). The green logistics evolution has challenged logistics and supply chain companies' traditional way of thinking by introducing the concept of 'green'. Carbon dioxide ($CO_2$)

emissions and greenhouse gases are a major concern for fleet operating companies, as pressure grows to manage the prospective environmental damage caused by fleet operating companies that will require fleet managers to report back on emissions generated by fleets (Fleet, 2013). A strategic universal challenge in the 21st century is condensing greenhouse gas emissions (Smith & Perks, 2010). Due to social awareness, corporate environmentalism, government legislation and management, the movement towards green logistic practice is being enforced globally by logistics and supply chain enterprises (Natarajan & Wyrick, 2011).

The current study focused on the topic of green logistics practices currently implemented by logistics and transport companies in South Africa, more specifically in the province of Gauteng. Furthermore, the drivers, barriers and benefits of implementing these practices were investigated. The primary objective of this study was to develop a framework in green logistics for logistics and transport companies in South Africa. A framework was drafted by exploring the green logistics practices that logistics and transport companies in Gauteng were implementing at the time of the research, and then by identifying certain green practices which small and medium enterprises (SMEs) and large companies could implement and from which they could benefit, in order to develop guidelines for SMEs and large companies to achieve environmental sustainability. SMEs play an essential role in a country's growth and development, and have the ability to make an important contribution to the sustainable industry of such a country (Rasi, Abdekhodaee & Nagarajah, 2010).

## 1.2 BACKGROUND TO THE STUDY

- *Defining key concepts*

Logistics management is defined by the Council for Supply Chain Management Professionals (CSCMP) (2010:114) as –

> *… that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfilment, logistics network design,*

*inventory management, supply/demand planning, and management of third party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved in all levels of planning and execution-strategic, operational, and tactical. Logistics management is an integrating function which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions, including marketing, sales, manufacturing, finance, and information technology*.

Most companies in South Africa make use of long-distance transport and logistics services. Long-distance road freight transport is not sustainable for both the infrastructure and the environment, as it contributes to the deteriorating road conditions in South Africa, as well as the high percentage of greenhouse gasses emitted annually by the transportation sector (Viljoen, 2012). Over the last few years, attention has been paid to the effect that logistics have on climate change, due to the increased awareness of the threat that global warming currently poses (McKinnon, Cullinane, Browne & Whiteing, 2010). This emphasises the importance of implementing green logistics practices.

Green logistics are defined by Thiell, Zuluaga, Montañez and Van Hoof (2011:335) as "… all activities related to the eco-efficient management of the forward and reverse flow of products and information between the point of origin and the point of consumption whose purpose is to meet or exceed customer demand". Rodrigue, Slack and Comtois (2013:274) define green logistics as "Supply chain management practices and strategies that reduce the environmental and energy footprint of freight distribution. It focuses on material handling, waste management, packaging and transport." Therefore, it can be said that green logistics are the activities or practices that aim to reduce the environmental effects of logistics practices by introducing the eco-efficient management of the forward and reverse flow of products. Green logistics practices can also be implemented to achieve more sustainable business practices.

The World Commission on Environment and Development's (WCED) Brundtland Commission (1987) defined sustainability as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Further, environmental sustainability can be defined as "a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity" (Morelli, 2011:23). This entails that transport and logistics organisations, large and small, consider the environmental impact of daily operations within the organisation in order to preserve resources for future generations while generating revenue.

Small businesses are frequently portrayed as the centre of the European Union (EU) economy, as the 23 million small organisations in these countries represent 99% of all business activities and create around 90 million working opportunities (Harvey, 2012). SMEs are accountable for almost two thirds of industrial emissions (Harvey, 2012). Organisations, specifically small to medium-sized firms, are burdened to continue their operations as well as to condense or eliminate environmental damage (Rasi *et al.*, 2010). However, in environmental policy, particularly regarding climate change, SMEs have commonly been overlooked, as over the last few years, the focus has been on convincing large companies to reduce greenhouse gas emissions (Harvey, 2012). According to the Government Gazette (2003) a medium-sized enterprise in the transport sector typically has a total of 200 full-time paid employees, with a turnover of R26 million and a total gross asset value of R6 million. A small enterprise, on the other hand, typically has a total of 50 full-time paid employees, with a turnover of R13 million and a total gross asset value of R3 million, as displayed in Table 1.1 below.

**Table 1.1: Classification of small and medium enterprises**

| **Sector or subsector in accordance with the Standard Industrial Classification** | **Size of class** | **Total full-time equivalent of paid employees** | **Total turnover** | **Total gross asset value (fixed property excluded)** |
|---|---|---|---|---|
| **Transport, Storage and Communications** | Medium | 200 | R26 million | R6 million |
| | Small | 50 | R13 million | R3 million |
| | Very small | 20 | R3 million | R0.60 million |
| | Micro | 5 | R0.20 million | R0.10 million |

**Source: Adapted from the Government Gazette (2003)**

Tajani, vice-president of the European commission (EC), stated that it is of the utmost importance that small businesses are encouraged to promote green jobs, green products and services with the aim of reducing their environmental impact (Harvey, 2012). Environmental goals cannot be achieved by European countries without a clear focus on small and medium enterprises (SMEs). Green logistics initiatives are promoted strongly by European countries while ranked highly at macro level (Beskovnik & Jakomin, 2010).

Bearing Point conducted a survey in 2008, including 600 supply chain professionals across Europe, the United States and Japan (McKinnon *et al.*, 2010). The survey revealed that close to 35% of the companies had a green supply chain strategy, with this percentage rising to 54% for enterprises with an annual turnover over $1 billion (McKinnon *et al.*, 2010). While European countries promote many activities regarding environmental conservation, South Africa being part of the Brazil, Russia, India and China (BRICS) grouping, an association of five major emerging national economies, needs to acknowledge the impact of logistics enterprises on the environment and to acknowledge the country's responsibility to move towards a low-carbon economy and reduce greenhouse gas emissions (Viljoen, 2012).

- *Perspectives on green logistics*

In December 2010, South Africa was the only African country to be asked to join the BRICS grouping. This came as no surprise as South Africa's economy is considered advanced compared to the rest of Africa and it is ranked with the third highest infrastructure compared to the China, Russia, Brazil and India as displayed in Table 1.2 below.

**Table 1.2: BRICS infrastructure rankings, 2011–2012**

| **Infrastructure** | **Rankings** |
|---|---|
| China | 44 |
| Russia | 48 |
| **South Africa** | **62** |
| Brazil | 64 |
| India | 89 |

**Source: Provincial Economic Review and Outlook (2012:7)**

Table 1.3 reflects the BRICS grouping's total $CO_2$ emissions emitted in million tons from fuel combustion by sector with electricity and heat allocated to consuming sectors in 2008. Table 1.3 consists of six categories, namely total $CO_2$ emissions from fuel combustion, other energy industries, manufacturing and construction industry, all transport, road transport and other sectors. In most categories, China has the highest scores of $CO_2$ emissions emitted and South Africa the lowest scores, except for two categories, namely manufacturing and construction and other sectors, while Brazil has the lowest score. The single BRICS country with scores most similar to South Africa is Brazil.

**Table 1.3: $CO_2$ emissions from fuel combustion (in million tons of $CO_2$)**

| **Country** | **Total $CO_2$ emissions from fuel combustion** | **Other energy industries** | **Manufacturing and construction** | **All transport** | **Road transport** | **Other sectors** |
|---|---|---|---|---|---|---|
| Brazil | 364.60 | 27.90 | 128.20 | 149.70 | 134.60 | 58.80 |
| Russian Federation | 1593.80 | 193.90 | 536.0 | 274.0 | 131.90 | 589.90 |
| India | 1427.60 | 50.70 | 652.80 | 147.40 | 121.10 | 576.70 |
| China | 6550.50 | 467.40 | 4143.40 | 482.20 | 334.40 | 1467.50 |
| **South Africa** | **337.40** | **16.20** | **163.10** | **49.50** | **42.30** | **108.60** |

**Source: King (2011: 36)**

Carbon tax is to be introduced in South Africa (SA) through legislation in 2016. In addition, it is stated that South Africa would be the second BRICS nation and the first African country to initiate a tax aimed at decreasing the emission of gases linked to climate change (Blaine, 2013). The tax would start at the rate of R120/ton of $CO_2$ equivalent, coming into effect from 2016. The rate would increase at 10% annually during the initial implementation phases (Blaine, 2013).

Furthermore, "In 2010 the BRICS represented over a quarter of the world GDP, up from 18% in 1990. In 2008, these five countries represented 31% of global energy use and 35% of $CO_2$ emissions from fuel combustion" (King, 2011:36). An increase in economic growth is being experienced by these developing countries contributing towards global development (King, 2011). According to 2008 emissions, South Africa is categorised as the 13th largest emitter of $CO_2$ in the world (Viljoen, 2012).

South Africa will have to take steps to reduce the amount of future emissions and energy utilised, as the transport sector is responsible for 10.5% of emissions emitted, and ranked as the third highest sector emitting greenhouse gas emissions, with the electricity sector ranked first with the highest percentage of 47.6% and basic metals and metal products in second place responsible for 22.2% followed by the other sectors (Viljoen, 2012). See Figure 1.2 below.

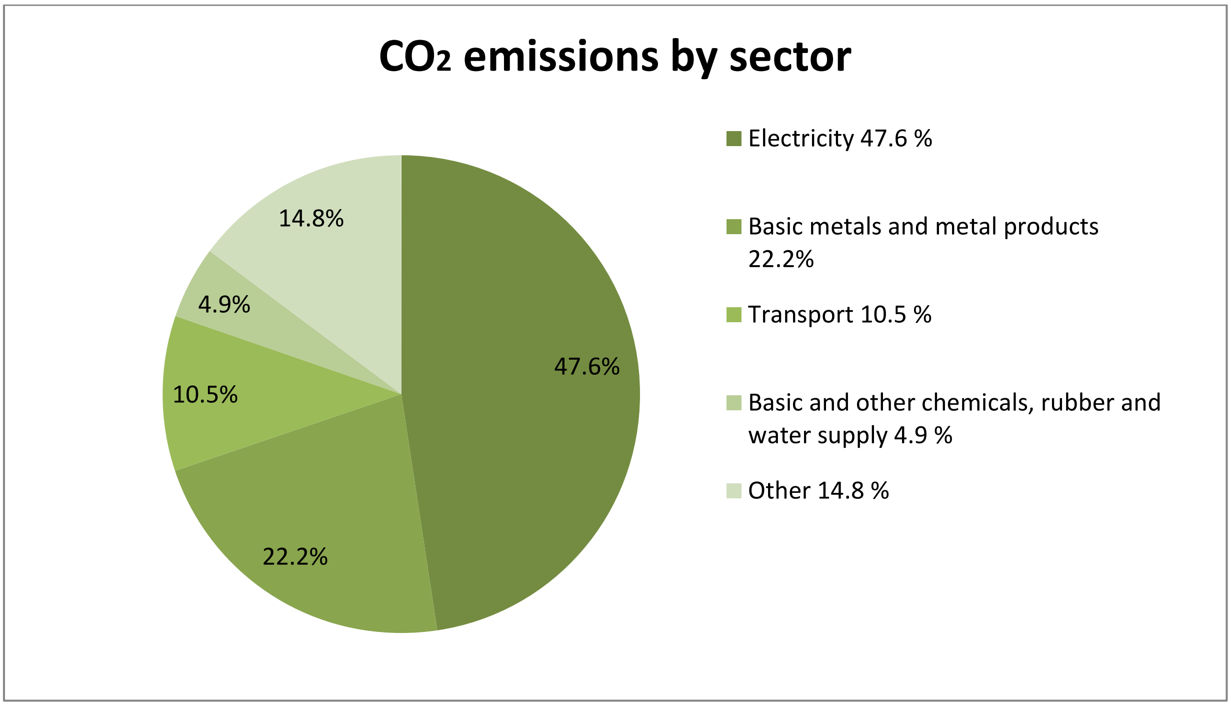


**Figure 1.2: Amount of $CO_2$ emissions emitted by various South African sectors**

**Source: Republic of South Africa (RSA) (2010:17)**

Transport and logistics companies in South Africa, regardless of their size, are confronted with rising regulatory pressure, which will force companies to put strategies in place in order to adhere to future environmental regulations and enhance environmental sustainability, thereby promoting green logistics and green transport practices (Smith & Perks, 2010).

Environmental regulations are focused on multinational logistics companies to promote sustainable development as well as creating a sustainable environment (Blundel, Monaghan

& Thomas, 2013). To achieve this, the practice of green management[1] has been promoted strongly over the last decade by large enterprises that are global competitors in their field (Lee, 2009). Green management developed in the 1990s, and Lee (2009) defines the term as the method by which various organisations oversee environmental or green activities and develop environmental management strategies.

The large[2] supply chain and logistics enterprises are fully aware of the environmental impact their services have on the environment. Large supply chain management enterprises integrate green practices in the supply chain to reduce $CO_2$ emissions, effluents and waste by automating the enterprises' warehouse management system, minimising inventories, recycling pallets and consolidating freight (Thiell *et al.*, 2011). Green products are being manufactured and designed in such a way that it saves energy consumption. Every aspect of the supply chain is scrutinised to see whether changes can be made to save energy and water and to create biodiversity (McKinnon *et al.*, 2010). These enterprises are preparing to adhere to the laws and regulations of carbon tax by incorporating green practices in their supply chain management practice.

Although large logistics and transport enterprises are implementing these practices, SMEs will also have to adhere to the environmental regulations, as they produce a considerable amount of environmental pollution (Del Brio & Junquera, 2003). A study by Olawale and Garwe (2010) revealed that SMEs in South Africa struggle to grow, with an estimated failure rate of 75%. This can be seen as a topic of concern, as SMEs are considered a key factor to resolve South Africa's economic development problems. By providing SMEs with the correct tools to sustain the development of business, in this case through a green logistics framework, possible prevention of high failure rates can be achieved.

Factors, such as restricted financial resources, organisational structure as well as managers and staff's lack of environmental training and awareness prevent SMEs from implementing green logistics practices (Del Brio & Junquera, 2003). By providing SMEs with the correct tools and guidelines to implement these green logistics practices SMEs can achieve business

[1] Green supply chain management (GSCM): accomplish profit and market share objectives by minimising environmental impacts and expanding ecological efficiency (Ahi & Searcy, 2013:335).
[2] According to QFinance, a large sized business can be defined as "an organisation that has grown beyond the limits of a medium-sized business and has 250 or more employees" (QFinance, 2009).

sustainability by focusing on the three pillars of sustainability: profit, people and the planet, where green logistics contribute to the ecological (planet) component of sustainability. By implementing green logistic practices, companies can reduce business costs, optimise logistics flow, improve corporate social responsibility and fuel efficiency, reduce emissions, waste, toxic materials and attract new customers (McKinnon *et al.*, 2010).

> *Furthermore, a business can enhance its competitiveness through improvements in environmental performance to comply with environmental regulation, to address the environmental concern of customers and to reduce the environmental impact of its product and service activities* (Smith & Perks, 2010:2).

## 1.3 PROBLEM STATEMENT

Over the last number of years, an increased concern was raised globally by public associations and government establishments for the environment, compelling logistics and transport companies to adhere to the increasing pressure to decrease the environmental impact of their daily logistics operations (King & Ittmann, 2010).

> *The impact of logistics on climate change has attracted increasing attention while research has revealed that global warming presents a much greater and more immediate threat than previously thought. These concerns have led to what is now known as green logistics* (King & Ittmann, 2010).

Various developed countries such as Japan, the United States and Germany have already advanced green logistics strategies in place (Xiu & Chen, 2012), while emerging markets are under increasing pressure to implement logistics integration practices in order to be seen as a global competitor (Green, Whitten & Inman, 2008). In South Africa, the concept of green logistics is relatively undeveloped and the implementation of green logistics activities demands urgent attention (Göransson & Gustafsson, 2014).

There exists a lack of research regarding the topic of green logistics in South Africa, with currently only a few studies available which investigated this topic. According to Göransson and Gustafsson (2014) the majority of logistics research in South Africa focused on the current state of logistics in South Africa (as compiled by the University of Stellenbosch, the Council for Scientific and industrial Research [CSIR] and Imperial Logistics) and the logistics costs within South Africa (Havenga, 2010). Smith and Perks (2010) conducted a study within the Nelson Mandela Metropole, on the perceptions of businesses regarding the impact of green practice implementation on business functions. Göransson and Gustafsson (2014) recently conducted a study about the managerial perceptions in the road transportation industry regarding green logistics in Johannesburg, South Africa.

Therefore, a lack of research exists regarding the extent to which logistics companies in South Africa implement green practices, and the barriers which are preventing companies from implementing these activities (Göransson & Gustafsson, 2014). These authors believe there is a gap in terms of research examining the drivers and benefits of implementing green logistics practices within South African logistics companies.

In addition, the latest studies on this topic revealed that only large organisations implement a pro-active environmental strategy, whereas SMEs are more inclined to adhere to external demands, therefore implementing a reactive strategy (Bianchi & Noci, 1998). The environmental impact of SMEs is currently being underestimated. Most of the environmental studies performed focused on large enterprises while studies focusing on SMEs are neglected and rare (Del Brio & Junquera, 2003). Most companies adopting environmental initiatives are large enterprises, while SMEs face a large number of barriers and drivers affecting the smooth adoption of sustainable practices (Meqdadi, Johnsen & Johnsen, 2013).

One of the main problems identified in the literature is the lack of environmental awareness that exists amongst SMEs (Winston, 2012). SMEs are struggling to achieve sustainable measurements, because there are no comprehensive guidelines for SMEs to follow in order to assist SMEs with the transformation process towards a more sustainable environment (Sloan, Klingenberg & Rider, 2013). According to Ittmann, large logistics and transportation companies in South Africa are advancing towards the implementation of green practices to achieve sustainability, while the problem seems to be the numerous small logistics companies that exist, which also affect green transportation (Göransson & Gustafsson, 2014). The current study aimed to solve the problem by developing a framework in green logistics for SMEs and large logistics companies, and to provide guidelines for SMEs on how to implement green logistics practices thereby indicating which green logistics practices are best to implement in order to achieve business sustainability and possibly reducing the negative effect on the environment. The drive towards green logistics is one of the major research priorities in South Africa (King & Ittmann, 2010).

Therefore the problem statement for the current study was phrased as: *What are the green logistics practices that logistics and transport companies in the industry are currently implementing in terms of key drivers, benefits and barriers, and how can these companies benefit from green practices while achieving future goals and promoting sustainability in South Africa?*

### 1.3.1 Purpose of this study

The main purpose of the current study was to identify the green logistics practices of logistics and transport companies specifically located in Gauteng (South Africa), and to explore their practices in this regard. Furthermore, the drivers, barriers and benefits of implementing these practices were determined. A framework was drafted for SMEs and large companies, outlining green logistics practices or tools they could use or implement in their own businesses to benefit from going green. Finally, guidelines on green logistics practices for SMEs and large companies were compiled, in order to enhance sustainable development as well as achieving future goals.

The importance of SMEs to the economy of South Africa is typified by a study conducted by Quartey and Abor (2010), which revealed that SMEs in South Africa contribute between 52% and 57% to the gross domestic product (GDP), 61% to employment and approximately 91% of formal businesses are SMEs. In addition Daniels, chief executive officer of the South African Institute of Professional Accountants (SAIPA) stated that SMEs are known worldwide as the driver behind economic growth and employment, a role acknowledged by the South African government; however, these initiatives still needs to be coordinated to achieve the utmost efficiency (Finweek Staff, 2012).

Unemployment poses a risk to the social structure of our society, and SMEs can assist to face this challenge (Finweek Staff, 2012). The purpose of the current study was therefore to determine the green logistics practices of logistics and transport companies in South Africa, more specifically in Gauteng, and to determine how these could be adapted for SMEs and large companies in the country. These will provide SMEs and large companies with guidelines on how to promote business sustainability by implementing these practices in order to enhance business sustainability for future generations as well as gaining a competitive edge amongst other SMEs and complying with government regulations.

In drafting these guidelines, emphasis was also placed on ensuring that these guidelines would be feasible for SMEs from a financial point of view. Finally, the aim was therefore on exposing companies in Gauteng to the concept of green logistics, and on developing a framework around green logistics which larger companies and SMEs could use and implement in their businesses.

### 1.3.2 What are the possible practical contributions of the study?

The main contributions of the research reported here were:

- to provide SMEs and large companies with a framework and recommendations on how to implement green logistic practices which are financially achievable and which could possibly assist in the creation of green jobs in various sectors in South Africa; and
- to create awareness among logistics companies that saving the environment is important and will become inevitable, forming part of one's social corporate responsibility and adhering to the future environmental regulations imposed by government.

The findings of this study will also inform logistics companies about the benefits of implementing green logistics practices. These benefits include the optimisation of logistic flow, costs savings, improved brand image, reduced overall business costs and expanding to new markets (McKinnon *et al.*, 2010). Management of logistics and transport companies, planning to improve or expand their green activities, could find the results of the study beneficial for implementation in their organisational structure, thereby contributing to the success and sustainability of logistics and transport companies in South Africa through exposure to the concept of green logistics.

## 1.4 RESEARCH OBJECTIVES

The primary objective of the current study was to develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice.

Secondary objectives included:

- identifying the main drivers behind implementing green logistics practices;
- exploring the benefits of implementing green logistics practices;
- determining the barriers preventing companies from implementing green logistics practices;
- exploring green logistics practices of logistics and transport companies located in Gauteng;
- comparing green logistics activities of SMEs and large companies in Gauteng; and
- providing large companies and SMEs with guidelines on how to implement green logistics practices.

## 1.5 RESEARCH METHODOLOGY

In order to achieve the objectives of the study, a quantitative research approach was followed where a Lime survey served as the primary research instrument (Saunders, Lewis & Thornhill, 2012). The main research approach followed was both exploratory and descriptive (Saunders *et al.*, 2012). The study aimed to explore the green logistics practices companies in Gauteng, a province in South Africa, is currently implementing, and to describe these practices using descriptive and inferential statistics (Zikmund, Babin, Carr & Friffin, 2010).

Firstly, Chapters 2 and 3 provide a summary of the literature review that was conducted in order to gain an in-depth understanding of the concepts *sustainability*, *green logistics*, *drivers, benefits* and *barriers of green logistics* and *green logistics practices*, which international and local firms are currently implementing. The sources included in the literature review mostly comprised accredited journals contained in research databases such as EBSCOhost, ScienceDirect and Google Scholar with the main research key words being *green logistics, sustainability, sustainable logistics, sustainability in emerging markets, green supply chain management (GSCM), sustainable supply chain management* and *SMEs*. Other secondary sources included newspapers, local logistics and transport magazines, such as *Engineering News* and *Fleetwatch*, and surveys or reports published annually by the CSIR.

After the literature review had been conducted, a Lime survey was developed and piloted amongst two logistics companies in Gauteng and three academic experts in the industry. The pilot questionnaire was emailed in the first week of September 2014 to detect any weakness or design error. The target population of the study consisted of logistics and transport companies located in Gauteng, where a census was conducted. Cooper and Schindler (2011) mentioned two conditions in which case a census study is suitable; specifically when the population is small and when elements are different from each other, which is applicable to the research on which this study is based. A census entails that the researcher involves all elements in the target population (Cooper & Schindler, 2011).

The logistics and transport companies were identified using an online database called Braby's where companies' type of business, location and contact details are freely available on the internet (See Appendix D for the database). A total of 160 companies were identified. For the purpose of the study, the sample size referred to the population size. Therefore, the sample size consisted of 160 logistics and transport companies located in Gauteng, including SMEs and large companies (refer to Chapter 4). One of the main reasons for including small and large logistics and transport companies was to gain an in-depth understanding of the green logistics situation in South Africa, and to determine to which extent green activities were being implemented by companies of different sizes at the time of the research.

The survey (see Appendix B) which consisted of section A, B and C was specifically aimed at the top- and middle-level managers of these companies, because they are usually more up to date with environmental practices within the firm than lower-level management. Initial contact was made through email, inviting the respondents to participate in the Lime survey. Follow-up emails were sent weekly during the data collection period, namely the middle of September until the end of October 2014. The respective companies were frequently phoned to remind them to participate. The data collection period continued for six weeks from 9 September 2014 until 24 October 2014. A response rate of 22.5% was achieved, where the sample size (S) and size of the population group (N) equalled 160. Out of the 160 companies, 36 companies responded and only 21 companies completed the entire questionnaire.

Malhotra and Grover (1998) indicated that a response rate of 20% was sufficient for a constructive assessment of the survey. Data analysis was conducted using descriptive statistics, inferential statistics, an opportunity analysis, a portfolio matrix and cross-tabulations (Saunders *et al.,* 2012). Details of the research instrument are discussed in section 4.6.4.

Although some of the research results proved not to be statistically significant the main contribution and primary objective of the research study was achieved, by providing small and large logistics and transport companies in South Africa with a framework in green logistics, in order to expose those companies to the concept of green logistics and to provide them with recommendations on how to implement green practices aiming to achieve sustainability.

## 1.6 OUTLINE OF THE STUDY

**Chapter 1** is the introduction of the study, which focuses on the topic of the study. The background of the study explains the concepts *green logistics* and *sustainability*, and the way the logistics industry in South Africa is currently affecting the environment. The problem statement motivates why this study is so important followed by the possible contributions and research objectives of the study. The research methodology aims to explain how these objectives were met. Chapter 1 concludes with the outline of the study as depicted in Figure 1.3.

**Chapter 2** consists of a literature review regarding the conceptualisation of green logistics and sustainability. This chapter commences with an introduction and includes the following sections: Firstly, overviews of South Africa’s logistics costs are discussed followed by –

- the dimensions of sustainability and green logistics;
- SMEs’ adoption of environmental initiatives;
- logistics decisions that affect the environment; and
- green logistics initiatives implemented in SA companies.

Lastly, the paradoxes of green logistics are discussed. The chapter ends with a conclusion.

**Chapter 3** comprises a literature review, which highlights the main green logistics practices companies are implementing globally. These practices can be implemented on six hierarchical levels of a company, namely strategic, tactical, operational, organisational, technical and internal. The key drivers, benefits and barriers for the greening of logistics and supply chains are also discussed.

**Chapter 4** is the research methodology chapter, which explains the research design chosen, followed by the research objectives, problem statement, limitations and ethical considerations. The reliability and validity of the study are also discussed, ending with a conclusion.

**Chapter 5** presents the empirical results and findings of the study. Data analysis was conducted by means of descriptive statistics, inferential statistics, an opportunity analysis, a portfolio matrix as well as cross-tabulations. From the statistical results, a framework was drafted for logistics and transport companies in South Africa, followed by guidelines for large and small logistics companies on the implementation of green logistics practices in order to achieve sustainability. This chapter ends with a conclusion.

**Chapter 6** presents the conclusions drawn from the study and recommendations for future research. Best practices in green logistics for large companies and SMEs are suggested, and the summary of the findings of the green logistics framework is discussed.

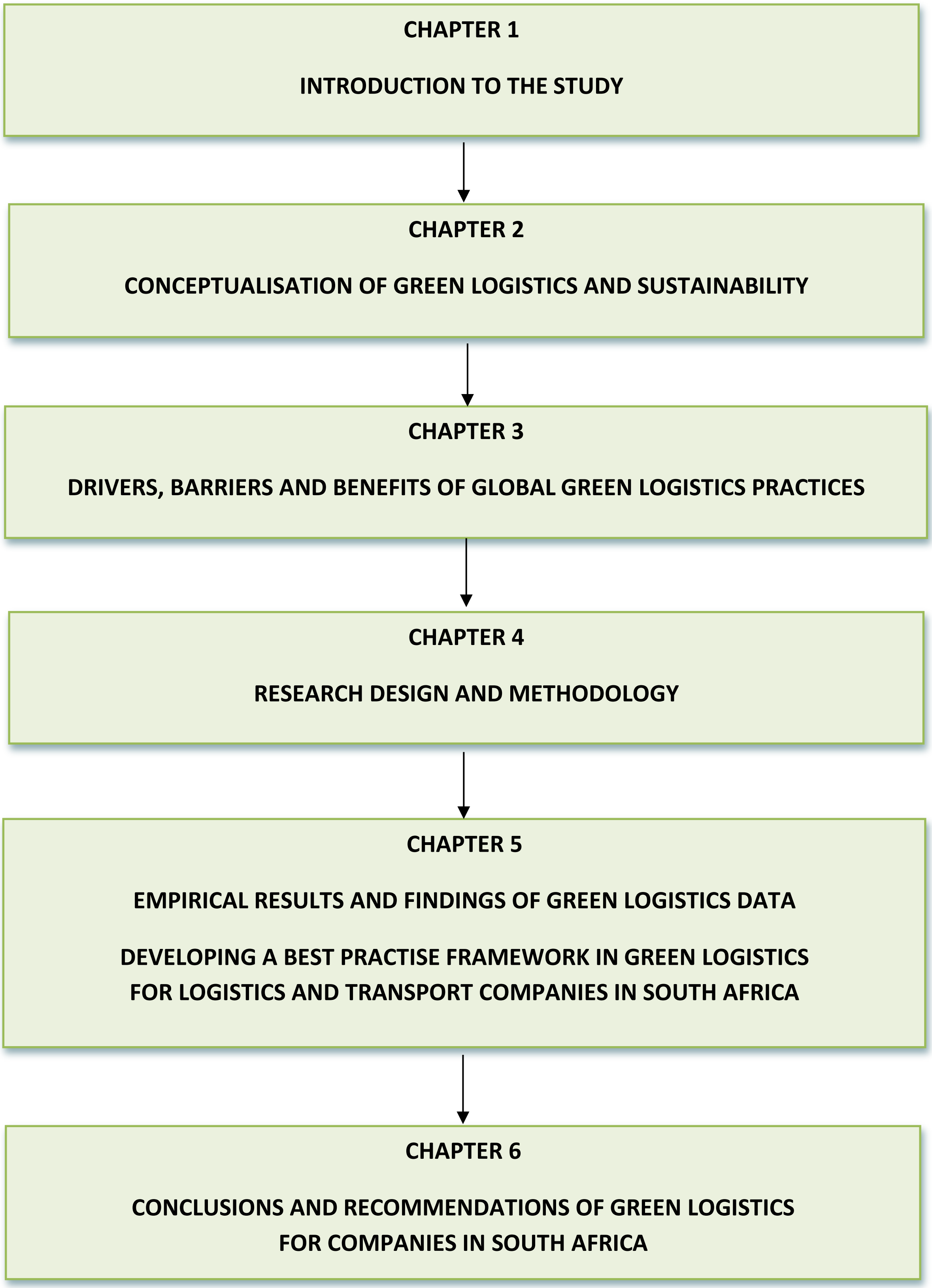


**Figure 1.3: Outline of the study**

# CHAPTER 2

# CONCEPTUALISATION OF GREEN LOGISTICS AND SUSTAINABILITY

## 2.1 INTRODUCTION

**Green logistics** is currently a fundamental and a key concept for enterprises striving to be sustainable (El-Berishy, Rügge & Scholz-Reiter, n.d). Global organisations are starting to experience the advantages of reducing the environmental impact of their businesses. "Sustainability drives efficiency – and this is particularly true in supply chain logistics" (Waters, 2013:1).

In Chapter 2, the concept of green logistics and sustainability among logistics and transport enterprises is discussed in more detail. The chapter follows the flow diagram in Figure 2.1.

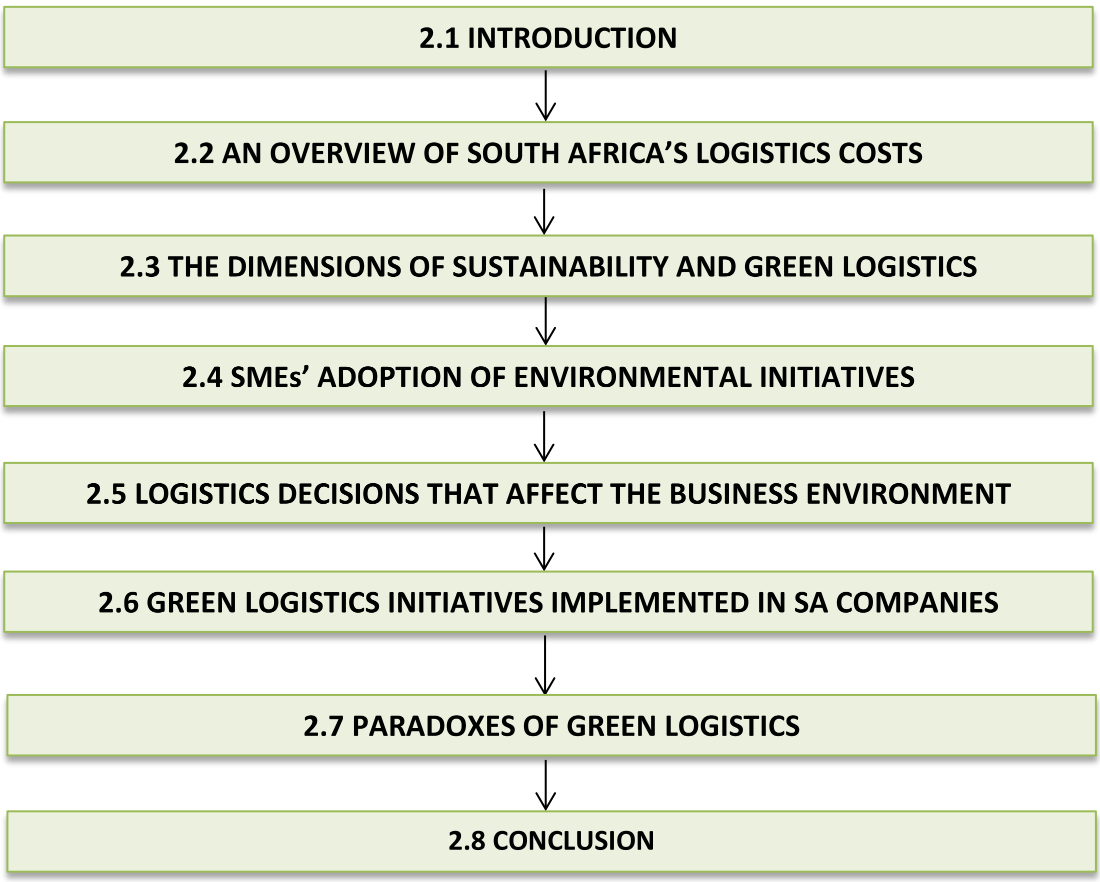


**Figure 2.1: Flow diagram of Chapter 2**

An overview of South Africa's logistics costs is outlined in section 2.2. This section highlights the major components of logistics costs in South Africa including a breakdown of South Africa's provincial logistics costs. Various long-term trends and transport constraints are identified in this section. Some of the key issues with which companies in the logistics and transportation industry are faced, are discussed in section 2.2.

In section 2.3, the dimensions of sustainability and green logistics are introduced, as this section focuses on the concept of sustainability within the logistics environment and the triple bottom line (TBL) concept. The adoption of environmental initiatives among transport and logistics companies – more specifically SMEs – is investigated in section 2.4. The drivers and barriers of SMEs' engagement towards environmental and sustainable initiatives are addressed in this section. Logistics managers are constantly faced with decisions regarding logistics activities that directly influence the environment. Logistics managers must therefore reconsider certain decisions in order to reduce the negative impact on the environment. Logistics decisions that affect the environment are discussed in section 2.5.

Section 2.6 describes some of the green logistics initiatives which South African logistics companies were implementing at the time of this research, whilst section 2.7 focuses on the paradoxes of green logistics. This section emphasises that there are certain trade-offs between the environment and the logistics firms by implementing green logistics practices. The chapter is concluded in section 2.8.

Green logistics symbolises several elements of research conducted over the last few decades merging together (McKinnon *et al.*, 2010). The same authors identified certain themes in green logistics that can be divided into five groups:

- reducing freight transport externalities;
- city logistics;
- reverse logistics;
- corporate environmental strategies towards logistics; and
- green supply management.

For the purpose of this study, the theme that was focused on was corporate environmental strategies towards logistics, more specifically green logistics.

## 2.2 AN OVERVIEW OF SOUTH AFRICA'S LOGISTICS COSTS

Before the concepts of sustainability and green logistics is discussed, it is important to understand the main components of logistics costs in South Africa, as well as the main issues the logistics and transportation industry faced in 2014. A brief summary is provided of the main components of logistics costs in South Africa.

**Logistics costs** is a term that is widely used in the transport and logistics industry and is acknowledged among academics (Pettersson & Segerstedt, 2013). Lambert, Stock and Ellram (1998) refer to logistics costs as cost elements associated with distribution, transport and warehousing costs, while Havenga and Simpson (2013) suggested that logistics costs can be divided into three direct elements, namely transport, storage and handling costs, management and administration costs and one indirect element namely inventory-carrying costs. The four elements of logistics costs, as displayed in Figure 2.2 below, will be used in Figure 2.4 to display South Africa's logistics costs per province and in Figure 2.5, the components of South Africa's logistics costs.

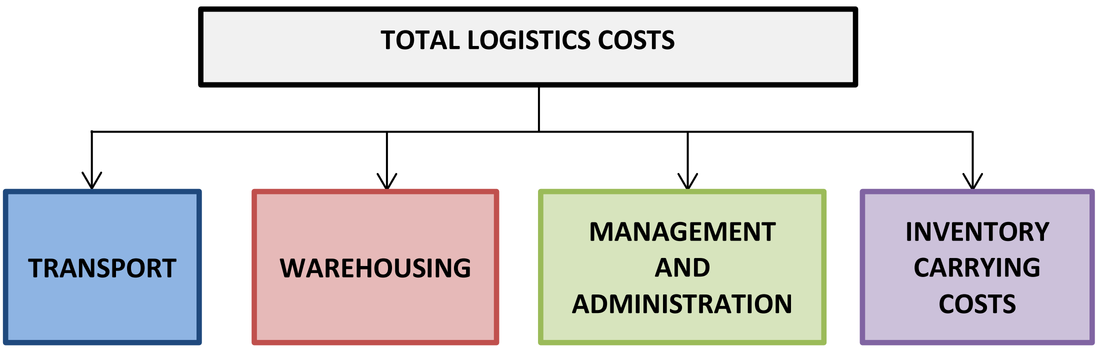


**Figure 2.2: The composition of total logistics costs**
**Source: Compiled by the researcher**

The logistics and transport industry has the ability of contributing largely to the economic growth of South Africa, as well as the competitiveness of our country (King & Ittmann, 2010:1). One of South Africa's greatest advantages is the country's location and ease of access of its seaports and airports, making it possible to expand its existing international transportation hub even further (Transport World Africa, 2013a).

According to Ernst & Young's attractiveness survey for Africa 2013, South Africa was ranked as the top destination country for infrastructure projects in Africa in 2013. The mainstream of the infrastructure projects was related to transport (41%), while the transport and logistics sector accounted for 42% of Africa's infrastructure projects up to 2013, and 41.5% of capital invested (Ernst & Young, 2013). Although international investors are expanding their investments and are constantly looking for new growth opportunities, the challenge exists to keep transport costs down in South Africa. South Africa needs to ensure that the country is seen as a key global competitor in its field in order to be part of these global projects.

South Africa's key to increased global competitiveness can be achieved by reducing the country's total costs of logistics by eliminating unnecessary expenses (Transport World Africa, 2013b).

Figure 2.3 below displays the provincial contribution to South Africa's economy.

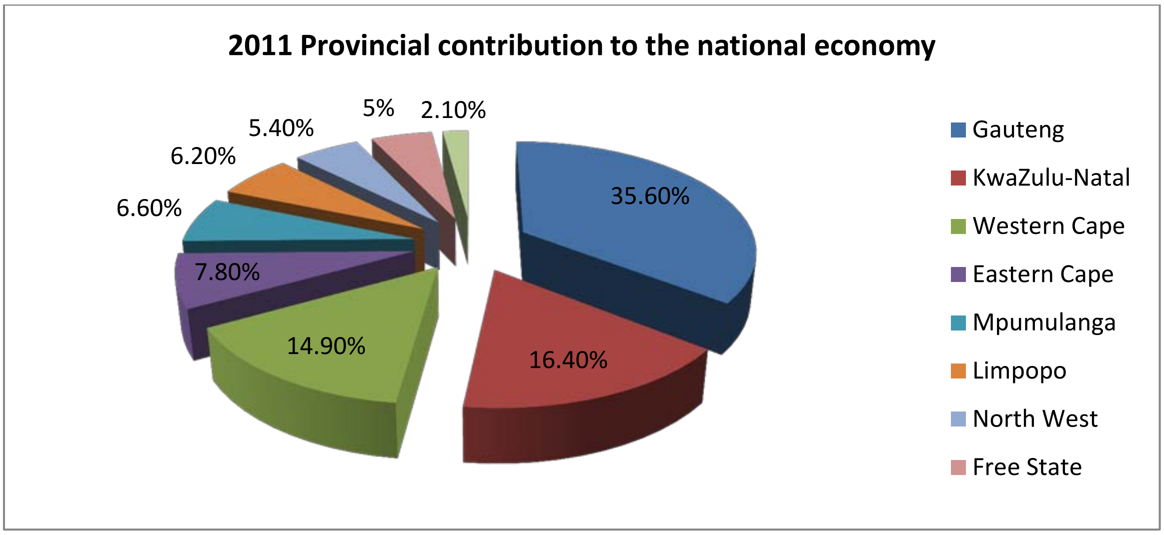


**Figure 2.3: The provincial contribution to the national economy in 2011**

**Source: Provincial economic review and outlook (2012:20)**

Over the last few years, the economy of South Africa struggled to grow due to the global economic crisis of 2008. According to Statistics South Africa (Stats SA) (2012), the growth rate for 2008 to 2012 averaged just over 2% per year, while the South African economic growth rate before the global economic crisis, was over 5% per year. The estimated economic growth rate for the year 2014 is only 2%, after the World Bank had decided to reconsider South Africa's economic growth forecast from 2.3% to 2% for 2014 (Vollgraaff, 2014). According to

Figure 2.3, Gauteng is the main contributor to the South African economy with the highest GDP, followed by KwaZulu-Natal, Western Cape, Eastern Cape, Mpumalanga, Limpopo, North West, Free State and the Northern Cape.

As displayed in Figure 2.3, the following observation made by the CSIR Built Environment is confirmed. There is a positive link between the provincial logistics capability (PLC) of a province and the provincial economy. The benchmarks to measure PLC, such as infrastructure, road, rail, ports, pipelines and information technology, compensates for everything else followed by the costs and skills of labour (Transport World Africa, 2013b). The top three provinces that contribute most to South Africa's economy are Gauteng, KwaZulu-Natal and the Western Cape. These are the provinces with the best road infrastructure in South Africa, as illustrated in Figure 2.3. The lower-ranked provinces (Eastern Cape, Mpumalanga, Limpopo, North West and Free State) are struggling with poor infrastructure and ranked at the bottom of the list.

Figure 2.4 displays the logistics costs per province broken down into four cost components namely, transport, warehousing, management and administration as well as inventory carrying cost as in 2011.

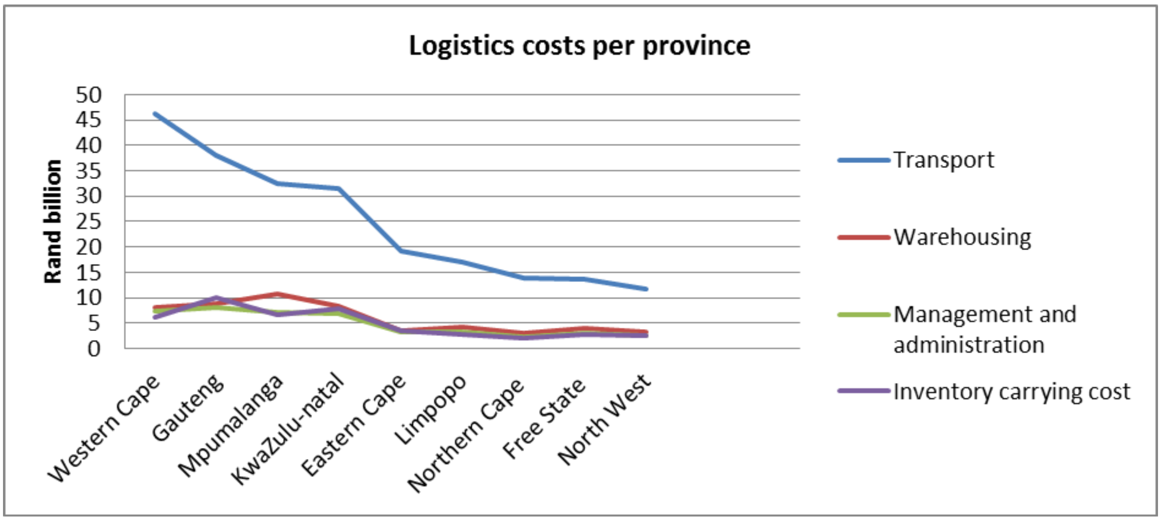


**Figure 2.4: Logistics costs per province in South Africa for 2011 broken down into cost components**

**Source: Adapted from Viljoen (2012:37)**

An interpretation of Figure 2.4 gives a clear indication of the features of South Africa's logistics costs per province. From the figure, the following assumptions can be made:

- The Western Cape has the highest logistics costs as well as transportation costs. This can be due to the long distances travelled from the Western Cape to Gauteng, and from the Western Cape to Durban.
- Gauteng has the second highest transport costs and highest inventory carrying costs. This can be as a result of the value of the automotive industry of the province.
- Mpumalanga is ranked third after the Western Cape and Gauteng, with the third highest transport costs followed by KwaZulu-Natal, Eastern Cape, Limpopo, Northern Cape, Free State and North West, in that order.

The CSIR study confirms the increasing role of transport in logistics costs and the significance of finding solutions for a transport-starving economy (Viljoen, 2012). Figure 2.5 below displays the components of logistics costs in South Africa.

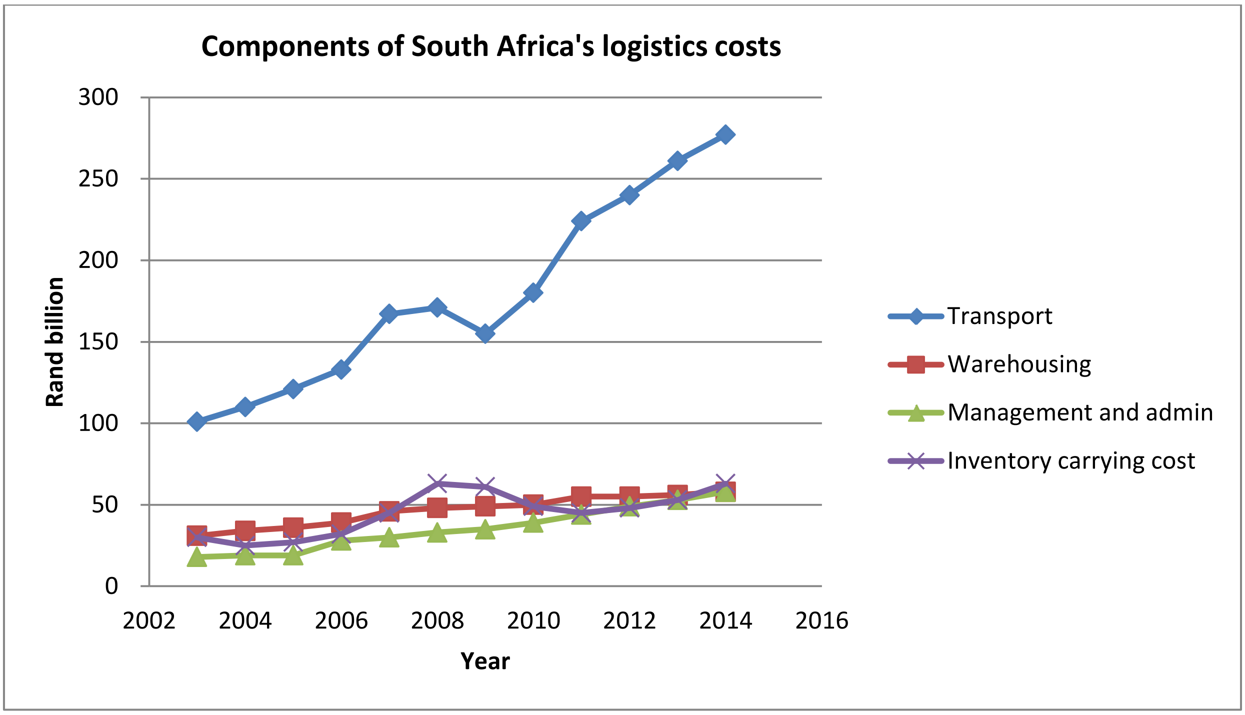


**Figure 2.5: Components of South Africa's logistics costs**

**Source: Adapted from Havenga, Simpson and De Bod (2013:3) (Viljoen, 2014)** [3]

From Figure 2.5, the four major logistics cost components between 2003 and 2014 are evident, namely **inventory carrying cost**, **transport**, **warehousing**, **management** and **administration**. The following interpretations can be made according to this figure: of specific

[3] The logistics costs for 2013 were estimated and forecasted for 2014.

importance is that for the last ten years (2003 to 2012), transportation costs have been the biggest cost component of South Africa's total logistics costs. Although inventory carrying costs reduced significantly from 2009 to 2011, transportation costs increased drastically from 2009 to 2013. A possible reason might be changes in the diesel price, the prime interest and inflation rates, and may be linked directly to the fluctuations in the four cost components. Transportation costs which increase annually are a major concern for the environment. Although logistics and transport managers are constantly looking for systems or methods to reduce high transport costs, the environment often 'pays' for these methods. This results in environmental costs often being externalised to compensate for high transportation costs. This topic is discussed further in section 2.8.

In a study by Havenga, Simpson and De Bod (2013) on macro-logistics trends in South Africa and the United States of America (USA), the authors identified a major long-term trend: transportation costs were making up a bigger portion of total logistics costs, while inventory costs were declining. This phenomenon, which was apparent in the USA, was also observed in South Africa. Furthermore, this trend could be enhanced by rising fuel prices and the forthcoming risk of emission costs being included in transportation costs. This will force companies to reassess their logistics–cost measurement strategies (Havenga *et al.*, 2013). At the time of the study, the fuel prices were high, but recently in December 2014, due to the fall in international oil prices, the petrol prices in South Africa reduced significantly (Karombo, 2014).

Barloworld Logistics (2014) conducted a supply chain foresight survey in South Africa. Of the respondents, 66% held director or general management titles across several business functions. This survey was conducted across various industries in South Africa of which 13% were from the logistics and transportation industry.

The respondents of the survey identified ten key objectives over the next five to ten years:

1) improving service levels to customers;
2) lowering procurement costs and reducing order lead times;
3) improving the flow of business intelligence;
4) integrating technology;

5) improving visibility in the supply chain;
6) aligning with key players in the supply chain;
7) warehousing and distribution optimisation;
8) optimising inbound and outbound transportation;
9) improving inventory deployment across the supply chain; and
10) outsourcing functions for cost and service improvement.

Improving service levels to customers was ranked as the most important key objective by the respondents of the Barloworld Logistics (2014) survey. The importance of customer relations was also evident in another survey conducted by an American-based company, EyeforTransport, in 2007, in which 271 transportation and logistics professionals responded to the survey and 70% of the respondents ranked improving customer relations as a top priority. From these studies it is evident that serving the customer and integrating logistics and business process can be seen as a major objective for local and global transport and logistics companies.

Furthermore, the Barloworld Logistics (2014) supply chain foresight survey identified long-term trends or objectives, but also identified the following ten supply chain and logistics constraints for the next five to ten years:

1) cost of transport;
2) reactive vs. proactive approach;
3) internal and external silo-based mentality;
4) availability of supply chain skills;
5) labour unrest;
6) ineffective processes and systems;
7) supply chain information and intelligence;
8) lack of overall supply chain strategy and tactics;
9) efficiency of ports and harbours; and

10) reluctance or foresight to change/innovate.

The respondents of the Barloworld Logistics (2014) survey voted cost of transport as the main logistics constraint for logistics and supply chain enterprises in South Africa. The freight transportation system of South Africa is restricted due to high costs, which negatively affects the country's economic growth (Allix, 2013). South Africa's road freight industry continues to be highly taxed. This can be due to rising toll fees, cross-border taxes, vehicle licence and inspection fees and, most important of all, increasing fuel prices (Visser, 2013).

The 2013 state-of-logistics survey compiled and conducted by Imperial Logistics, the CSIR and Stellenbosch University (Viljoen, 2014), highlights important issues regarding the logistics and transportation industry in South Africa. One of the key issues raised in this report is the total road and rail transportation activities in the South African economy as presented in Table 2.1 and Table 2.2.

From the tables on the next page, the high variance between the percentages of freight being transported by road and rail is evident. The main transport mode remains road transport. Because South Africa's railways are not being used to transport bulk commodities and fast-moving consumer goods, high volumes of freight over long distances are being transported by road, which results in poor and deteriorating road conditions and specifically damaging the corridors between Gauteng, Durban and Cape Town. It is very important for companies to realise that, in order to reduce carbon emissions and transportation costs, a modal shift from road to rail should be considered. Therefore, the environment is influenced dramatically by the high percentage of freight being transported by road, and transport companies should consider implementing green activities to reduce the negative effect on the environment.

**Table 2.1: Road and rail freight volumes for 2013**

| **Tonne-kilometre 2013 = 441 billion (bn)** | | | | | |
|---|---|---|---|---|---|
| | **Corridor[4]** | **Natcor & Capecor[5]** | **Metropoliton** | **Rural** | **Bulk mining** |
| **Road – 69.5%**<br>**306 bn** | 80 bn<br>18% | 73 bn<br>17% | 60 bn<br>14% | 92 bn<br>21% | |
| **Rail – 30.5%**<br>**135 bn** | 16 bn<br>3.6% | 9 bn<br>2.0% | 0.1 bn<br>0.0% | 25bn<br>5.6% | 85bn<br>19% |

**Source: Adapted from Viljoen (2014:41)**

**Table 2.2: Road and rail freight volumes for 2013**

| **Tonnage 2013 = 1 740 Metric ton (253)** *Figures in brackets represent the average transport distance in kilometres | | | | | |
|---|---|---|---|---|---|
| | **Corridors** | **Natcor & Capecor** | **Metropoliton** | **Rural** | **Bulk mining** |
| **Road – 87.9%**<br>**1 530 Mt (200)** | 157 Mt<br>(513)<br>9.0% | 88 Mt<br>(833)<br>5.0% | 789 Mt<br>(76)<br>45.0% | 496 Mt<br>(186)<br>29.0% | |
| **Rail – 12.1%**<br>**210 Mt (641)** | 27 Mt<br>(581)<br>1.6% | 10 Mt<br>(849)<br>0.6% | 2 Mt<br>(57)<br>0.1% | 50 Mt<br>(501)<br>2.9% | 121 Mt<br>(705)<br>6.9% |

**Source: Adapted from Viljoen (2014:41)**

Tables 2.1 and 2.2 show the significant difference in tonnage and tonne-kilometre (tkm) for freight volumes being transported by road and rail. Table 2.1 reflects that 306 billion tonnes of freight per kilometre are transported by road and 135 billion tonnes of freight per kilometre is transported by rail. Table 2.2 shows that 12.1% metric tonnes of freight is transported by rail and 87.9% metric tonnes of freight is transported by road. Natcor represents the KwaZulu-Natal–Gauteng Corridor and Capecor represents the Western Cape–Gauteng corridors. The remaining corridors are represented in the first columns of Table 2.1

[4] Remaining corridors excluding the two corridors
[5] Natcor (KwaZulu-Natal–Gauteng) and Capecor (Western Cape–Gauteng) represent the two main corridors

and Table 2.2. These figures pose many challenges in terms of transportation planning in South Africa and emphasise the importance of modal shift, from road to rail, as one of the goals for the economy (Viljoen, 2014).

In the ninth state of logistics survey emphasises is placed on strict rules that are going to be imposed regarding carbon emissions (Viljoen, 2013). Allix (2013) highlights that stringent carbon emission rules will result in consumer and supermarket chains, specifically in First World countries, not purchasing South African goods any more if these goods have to be transported over long distances by road. Therefore it is important for logistics and transportation companies to make the necessary changes to adhere to future government regulations such as carbon taxes to be implemented in South Africa from 2016.

Research by Havenga *et al.* (2013) referred to McKinnon’s (2012) well-researched summary of how logistics companies can green their supply chain and implement green logistics strategies in order to reduce carbon emissions. This can be achieved through better vehicle utilisation, optimising the routing of vehicles, increasing fuel efficiency, shifting freight to greener transport modes and restructuring logistics and supply chain systems.

Section 2.2 provided an overview of South Africa’s high logistics costs and how these affect the environment. The next section will focus on the dimensions of sustainability and green logistics. Research suggests that green logistics is an up-and-coming topic within the environmental aspect of sustainability (Winter & Knemeyer, 2013). Section 2.3 will discuss the relationship between green logistics and sustainability.

## 2.3 THE DIMENSIONS OF SUSTAINABILITY AND GREEN LOGISTICS

Sustainability plays an integral part in the growth and decision-making of organisations' business strategies (Oberhofer & Dieplinger, 2013). Sustainable decision-making is fundamental for companies in the transport and logistics sector, due to the effect on the environment. "In recent years, the business and management literature has focused increasingly on the integration of social, environmental and economic responsibilities as a definition of sustainability. This is broadly known as the triple-bottom-line approach[6] and suggests a balanced interplay of a company's concerns" (Oberhofer & Dieplinger, 2013:237).

Bouzon, Hedler Staudt, Taboada Rodriguez and Espíndola Ferreira (2012) compiled a comprehensive table, as displayed in Table 2.3 on the evolution of sustainability in the supply chain and logistics industry over the past few decades. According to Seuring and Müller (2008:1700), sustainable supply chain management (SSCM) can be defined as "the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements".

Pagell and Shevchenko (2014:45) define SSCM as the "designing, organizing, coordinating, and controlling of supply chains to become truly sustainable with the minimum expectation of a truly sustainable supply chain being to maintain economic viability, while doing no harm to social or environmental systems". Table 2.3 highlights the development of sustainability in the supply chain and logistics industry starting in the 1960s with the introduction of the negative effects of logistics on the environment. In the 1960s and 1970s, supply chain and logistics companies denied the environmental effect of their daily operations. In the 1980s, supply chain and logistics companies became aware of environmental issues raised. The publication of the Brutland Report (WCED, 1987) was one of the major sustainable events in the 1980s. In the 1990s, the concepts of *green logistics, green supply chain* and *reverse logistics* were defined. The triple bottom line (TBL) concept in sustainable supply chain management became apparent in 2000, while logistics were viewed as a competitive tool.

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[6] Metrics that measure ecological and social performance in addition to financial performance. Synonym: *People, Planet, Profit (CSCM, 2010)*

**Table 2.3: The evolution of sustainability in the supply chain and logistics industry**

| Decade/Year | Sustainable events | Source |
|---|---|---|
| **1960 and 1970** | Companies deny the negative effects on the environment. | Georgiadis & Besiou, 2008 |
| | Rise of corporate social responsibility. | Carroll, 1999 |
| **1980** | Beginning of awareness on environmental concerns related to logistics and transportation. | Chunguang, Xiaojuan, Kexi & Pan, 2008 |
| | Publication of the Brundtland Report. | World Commission on Environment and Development (WCED), 1987 |
| | Transformation from local optimisation to supply chain optimisation. | Linton, Klassen & Jayaraman, 2007 |
| **1990** | Environmental impact drives green logistics. | Chunguang *et al.*, 2008 |
| | The theory of green supply chain is defined. | Srivastava, 2007 |
| | CLM releases its first definition of reverse logistics. | Brito & Dekker, 2003 |
| **2000** | Logistics is viewed as a competitive tool. | Rutner & Langley Jr., 2000 |
| | Early work is published in 2002 containing TBL sustainability in supply chain. | Seuring & Müller, 2008 |
| **2010** | Sustainability is incorporated into business management. | Wittstruck & Teuteberg, 2010 |
| | Research works are published on the integration and management of SSCM. | |
| **2011** | The concept of risk management is covered in the sustainable supply chain. | Wolf, 2011 |
| **2012** | SSCM practices become popular among businesses. Companies in the private sector are using purchasing and supply to minimise environmental, economic and social impact. | Walker & Jones, 2012 |
| **2013** | Comprehensive literature reviews on various fields are available: closed-loop supply chains green supply chains, reverse logistics and SSCM. | Seuring, 2013 |
| **2014** | Significance of environmental factors and social aspects in supply chain management (SCM) becomes an important focus area for academic researchers and practitioners. | Brandenburg, Govindan, Sarkis & Seuring, 2014 |

**Source: Adapted from Bouzon *et al.* (2012)**

Over the last few years, the concept of sustainability in the supply chain and logistics industry gained importance, sustainability was incorporated in business management in 2010, and the concept of risk management introduced in 2011. SSCM practices became popular among businesses in 2012 (Walker & Jones, 2012). Companies in the private sector started using purchasing and supply to minimise environmental, economic and social impact (Walker & Jones, 2012). Comprehensive literature reviews on closed-loop supply chains, green supply chains, reverse logistics and sustainable supply chain management were available in 2013 (Seuring, 2013). Finally, in 2014, academic researchers and practitioners focused on the significance of environmental factors and social aspects in supply chain management (Brandenburg *et al.*, 2014). It is therefore clear, the concept of sustainability in the supply chain and logistics industry changed drastically over the years and decades; currently, sustainability is a key focus point for most organisations and academic researchers.

Globally, it has become a main priority for emerging countries such as South Africa to implement green practices while managing their TBL (King, 2011). The TBL promotes a profound interest for economic, ecological and social sustainability in organisational strategic development. In South Africa, the TBL concept has been focused on in the King III Report (PricewaterhouseCoopers, [PWC] 2009), and suggests that both large and small companies must abide by the codes of the King III Report (Smith & Perks, 2012; Van Wyk and Deegan, 2009). The King III Report is better known as the Report on Governance Principles for South Africa. It was implemented in March 2010 and applies to all entities, public, private and non-profitable, irrespective of establishment (PWC, 2009). The King III report comprises principles that companies, irrespective of size, could follow should they aim to practise good corporate governance.

Initially, economic, environmental and social dimensions were approached independently, but current belief aspires to join these three performances in order to enhance sustainable business performance and competitiveness (King, 2011). The TBL principle implies that management must include the 3 Ps, namely people, planet and profit in managerial decision-making in order to enable sustainable business performance (King, 2011).

Research by Sittinger (2013) on sustainable logistics in Germany's SMEs suggests that it is important to note the difference between sustainable logistics and green logistics. Green logistics management "… reflects organizational ability to conserve resources, reduce waste, improve operational efficiency, and satisfy the social expectation for environmental protection" (Lai and Wong, 2012:268), while green logistics focus on the economic and environmental aspect, sustainable logistics include the social dimension (Sittinger, 2013:13). Sustainable supply chain management consists of the traditional concept of supply chain management, extending the concept by adding the environmental and social/ethical dimension (Wittstruck & Teuteberg, 2011) (see Figure 2.6 below).

Figure 2.6 displays the TBL namely economic sustainability, social sustainability and environmental sustainability.

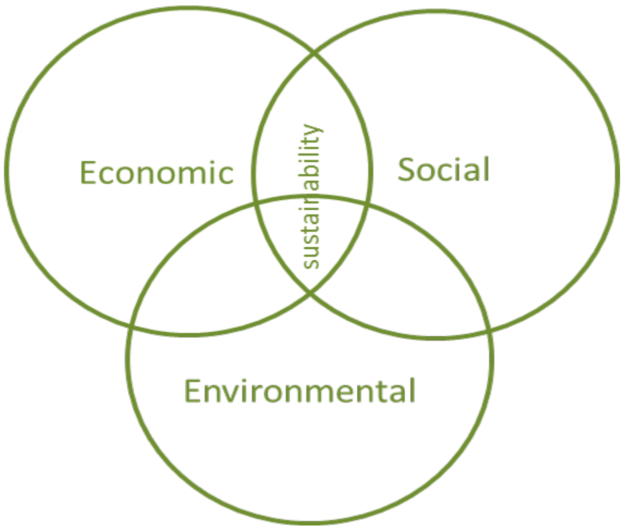


**Figure 2.6: Sustainability: The triple bottom line**
**Source: Adapted from Aras and Crowther (2013:6) and Sittinger (2013:12)**

Figure 2.6, the TBL, is a frequently used model to illustrate the concept of sustainability.

1. *Economic sustainability* – this dimension emphasises that logistics and transport firms must constantly attempt to reduce their total supply chain costs through balancing sustainable and strategic initiatives (Bowersox, Closs, Cooper & Bowersox, 2013). Göransson and Gustafsson (2014) describe the economical factor within the TBL as the economic value or revenues produced by a company. Furthermore, according to De Giovanni (2012), when assessing a company's performance, the economic factor is the most widely used measurement tool.
2. *Social sustainability* – often associated with CSR (corporate social responsibility). Van Marrewijk (2003) broadly defines CSR as firms displaying environmental and social concerns in business operations including interactions with stakeholders. These concerns can include the wellbeing of the community and the workers and include

measures such as safe working conditions, suitable working hours and enough resting time for drivers (Göransson & Gustafsson, 2014).

3. *Environmental sustainability* – currently there is an increasing idea that firms can escalate their profits by implementing sustainable practices (Bowersox *et al.*, 2013). The authors discuss three environmental perspectives that enhance environmental sustainability:

    - *Conservation* – includes ways to reduce carbon emissions, noise, pollution and fuel consumption.

    - *Usage reduction* – reduction of waste, greenhouse gasses and energy. Increasing recycling.

    - *Business management practices* – for example outsourcing manufacturing and logistics operations.

The TBL suggests that at the intersection of social, environmental and economic dimensions, there are practices which firms can engage in that affect the natural environment and society positively. These activities or practices result in continuing economic benefits and competitive advantages for the firm which practices these principles (Carter & Rogers, 2008).

While the traditional concept of sustainability includes the three Es namely economic, environment and equity and the three Ps namely people, planet and profit, Bowersox *et al.* (2013) propose a more extended sustainable framework by dividing the equity dimension into two dimensions namely ethical and educational.

Bowersox *et al.* (2013) fragment sustainability in four dimensions as presented in Figure 2.7: environment, ethics, education and economy.

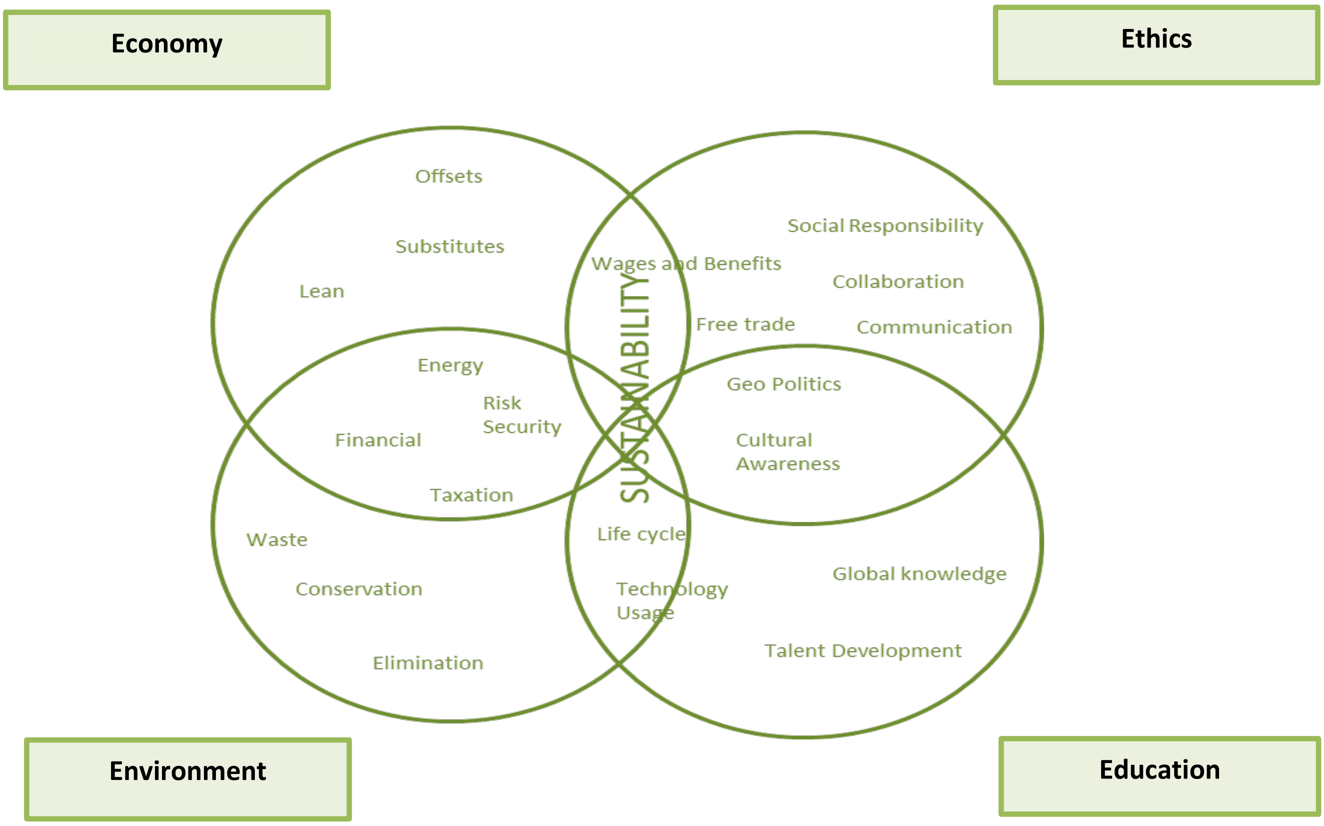


**Figure 2.7: Four dimensions of sustainability**

**Source: Bowersox *et al.* (2013:403)**

The traditional social dimension is divided into an ethical dimension and an educational dimension, which focus on ethical employee relationships, community involvement, cultural awareness and talent development with regard to sustainability. Figure 2.8 presents the concept of sustainability with regard to logistics and transportation.

Research by Jeon, Amekudzi and Guensler (2013) on sustainability assessment at transportation planning level in the Atlanta Metropolitan region, aimed to present the definition of sustainable transportation graphically as no exact definition currently exists. The authors suggest that four essential factors should be included in the features of a sustainable transportation system**.**

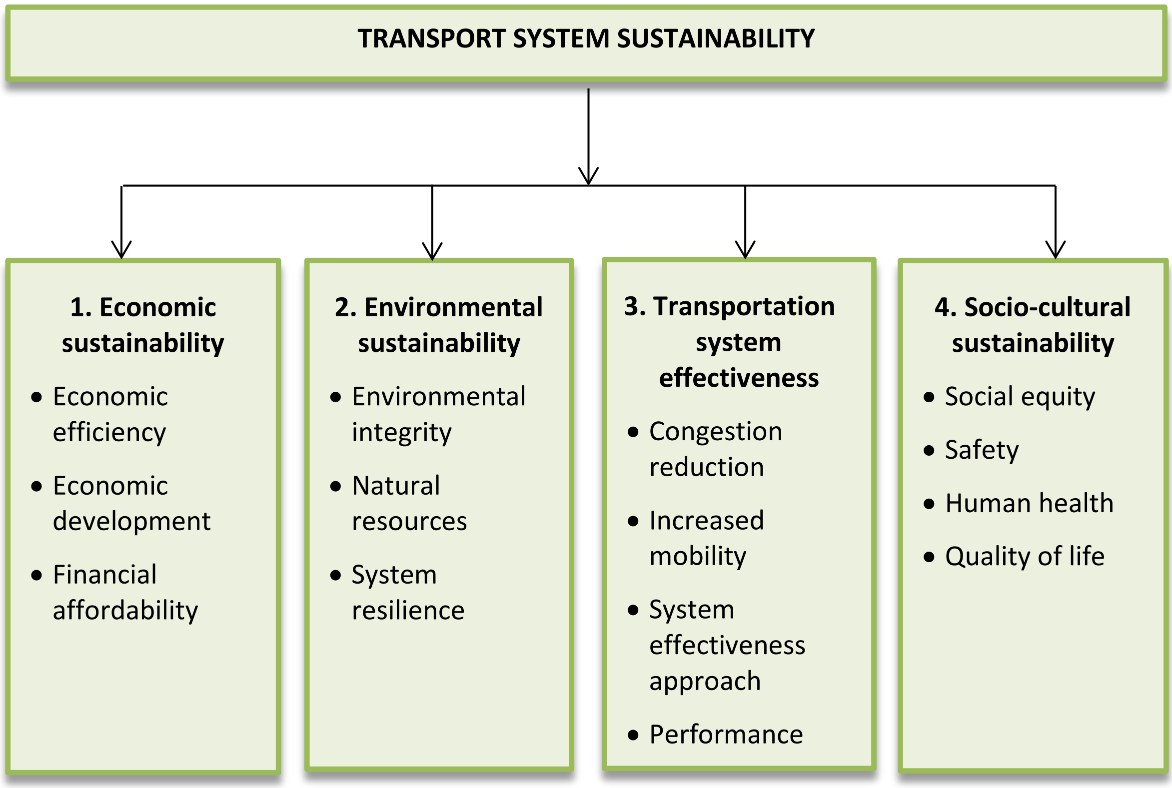


**Figure 2.8: Sustainability: Four essential factors of transportation system sustainability Source: Adapted from Jeon *et al.* (2013:11)**

Figure 2.8 illustrates the four crucial factors that should be incorporated in a sustainable transport system, namely economic, environmental and socio-cultural sustainability as well as transportation system effectiveness (Jeon *et al.*, 2013). Consensus have been reached regarding the transportation planning level which should include concerns about transportation system sustainability, in order to have any impact on business decisions being made (Jeon *et al.*, 2013).

From the interpretation of the figures (Figure 2.7 and 2.8) above, the concept of sustainability includes three dimensions namely economic, environmental and social. Bowersox *et al.* (2013) further divide the social dimension into an ethical dimension and an educational dimension, while Jeon *et al.* (2013) add transportation system effectiveness as one of the crucial elements to display transport sustainability.

As discussed in Chapter 1 (see 1.3), traditionally larger companies adopted sustainable practices easier, while SMEs have experienced more challenges.

Previous research shows that environmental management within small businesses is seen as a great challenge, and SMEs are less involved with environmental activities than larger companies (Brammer, Hoejmose & Marchant, 2012).

Small and medium-sized enterprises globally have the ability to affect the environment negatively; therefore it is important to pay attention to the environmental strategies of SMEs (Lewis, Cassells & Roxas, 2014).

The next section will focus on SMEs' adoption of environmental initiatives, the development of SMEs' environmental strategies and the drivers and barriers SMEs face with regard to transforming into more sustainable organisations.

## 2.4 SMEs' ADOPTION OF ENVIRONMENTAL INITIATIVES

### 2.4.1 Introduction

The conversion of SMEs into environmentally sustainable organisations is an area of interest that gains much attention by various researchers (Sloan *et al.*, 2013). Demartini, Kraus and Schulz (2011) undertook extensive literature research on the sustainable management of SMEs. They concluded that large companies have effectively implemented sustainable strategies, while sustainable strategies and practices in SMEs continue to be unheard of. However, a great amount of literature exists, although in the initial phases, regarding the challenges of transformation that SMEs face.

SMEs play a crucial but usually underestimated role in sustainable development (Meqdadi *et al.*, 2013). SMEs are confronted by larger customers to adopt environmental initiatives while simultaneously transferring these specific conditions to suppliers. "Thus, whether transformative change can be brought about in SMEs the same way it has been in large organisations is an issue which must be seen as looming importantly in the background as we move towards consideration of how change towards environmental sustainability specifically can be accomplished in SMEs" (Sloan *et al.*, 2013:21). Merrit (1998) addresses the important issue of improving the environmental performance of SMEs, and states that SMEs' specific organisational processes, internal structures and cultures need to be considered when sustainable initiatives are adopted.

### 2.4.2 Development of SMEs' environmental strategies

The process for SMEs to transform into organisations that are environmentally more sustainable can be challenging, and many aspects such as financial resources, organisational structure, management style, human resources, technology, etc. can influence the development of SMEs' environmental strategy. The authors Del Brio and Junquera (2003) provided a literature review on environmental innovation management in SMEs, and the implications for public policies.

Del Brio and Junquera (2003) identified nine aspects, which influence the development of SMEs' environmental strategies, and summarised the conclusion made by various studies:

1. *Financial resources:* The lack of financial and technical resources, unavailability of capital, as well as the high cost of environmental programmes are only few of the barriers that Meqdadi *et al.* (2013) identified as some of the main reasons why SMEs struggle to adopt environmental practices (refer to Table 2.9.4). In the long run, SMEs will be under pressure from suppliers and large organisation to comply with environmental standards; therefore it is crucial that SMEs use the necessary capital to implement green initiatives.
2. *Organisational structure*: Previous studies revealed that the particular features of an SME's organisational structure can obstruct the implementation of environmental actions. Although it can be easier to implement environmental practices in large organisations due to their fixed organisational structures, SMEs have an advantage of capacity that allows them to make changes more easily (Del Brio & Junquera, 2003).
3. *Management style:* Meqdadi *et al.* (2013) identified several drivers that can promote the implementation of environmental initiatives from a management perspective. Commitment, technical skills, existence of environmental awareness and expertise are important characteristics management should display in order to motivate staff to adopt these initiatives.
4. *Human resources:* Employees working for SMEs typically have limited knowledge of the environment as observed by Azzone, Bertelè and Noci (1997) and Azzone and Noci (1998). These emphasise the importance of enforcing training programmes for staff

members to promote environmental behaviour. Management should be able to motivate staff and create awareness of environmental practices among staff members by dedicating time and effort to create environmental programmes or training guides for employees.

5. *Environmental management status:* The idea of allocating personnel to a specific department which manages environmental issues is becoming increasingly more popular (Del Brio & Junquera, 2003).
6. *Manufacturing activity:* Globally, manufacturing organisations are compelled to evaluate the environmental damage caused by manufacturing processes. A study conducted by Klassen and Angell (1998) found that the flexibility of manufacturing activities can encourage environmental management.
7. *Technological approach:* One of the main disadvantages SMEs face is the lack of finances and capital resources. Therefore it is more difficult for small firms than for large firms to acquire green technologies due to their lack of resources.
8. *Innovative capacity:* Noci and Verganti (1999) conducted a study on the management of green product innovation in small firms, and concluded that SMEs can adopt well-developed environmental strategies, provided that SMEs have high levels of innovative capacity.
9. *External cooperation*: External relationships with third-party logistics services, public administration and research institutions can be seen as another disadvantage or obstacle for SMEs, due to SMEs' restricted capacity to form new relationships (Del Brio & Junquera, 2003; Noci and Verganti, 1999).

Logistics and transport managers of small and medium-sized firms must pay close attention to these nine aspects (financial resources, organisational structure, management style, etc.) when developing an environmental strategy for their firms. These aspects may affect the extent to which SMEs can implement environmental initiatives (Del Brio & Junquera, 2003). This together with the drivers and barriers that influence SMEs to take part in environmental and sustainable initiatives is specifically discussed in 2.4.3.

### 2.4.3 Drivers and barriers that influence SMEs to take part in environmental and sustainable initiatives

Meqdadi *et al.* (2013) conducted two pilot case studies in France, investigating how large manufacturers involve SME suppliers in sustainable initiatives and also the barriers and drivers for SME suppliers participating in sustainable initiatives. These authors suggest that SMEs' motivation to take part in sustainable initiatives, as well as the barriers preventing their participation may be different from those of larger firms. Meqdadi *et al.* (2013) identified several drivers and barriers in literature that influence SMEs to take part in environmental and sustainable initiatives.

These drivers and barriers are grouped into two categories. The first category is SMEs' capabilities and the second category is SMEs' supply network. The first category (SMEs' capabilities) is found where management and the organisation play an important role in encouraging environmental behaviour. Finance is also included in this group. The second category (SMEs' supply network) is found where external factors play a role, such as pressure from customers, laws and regulations.

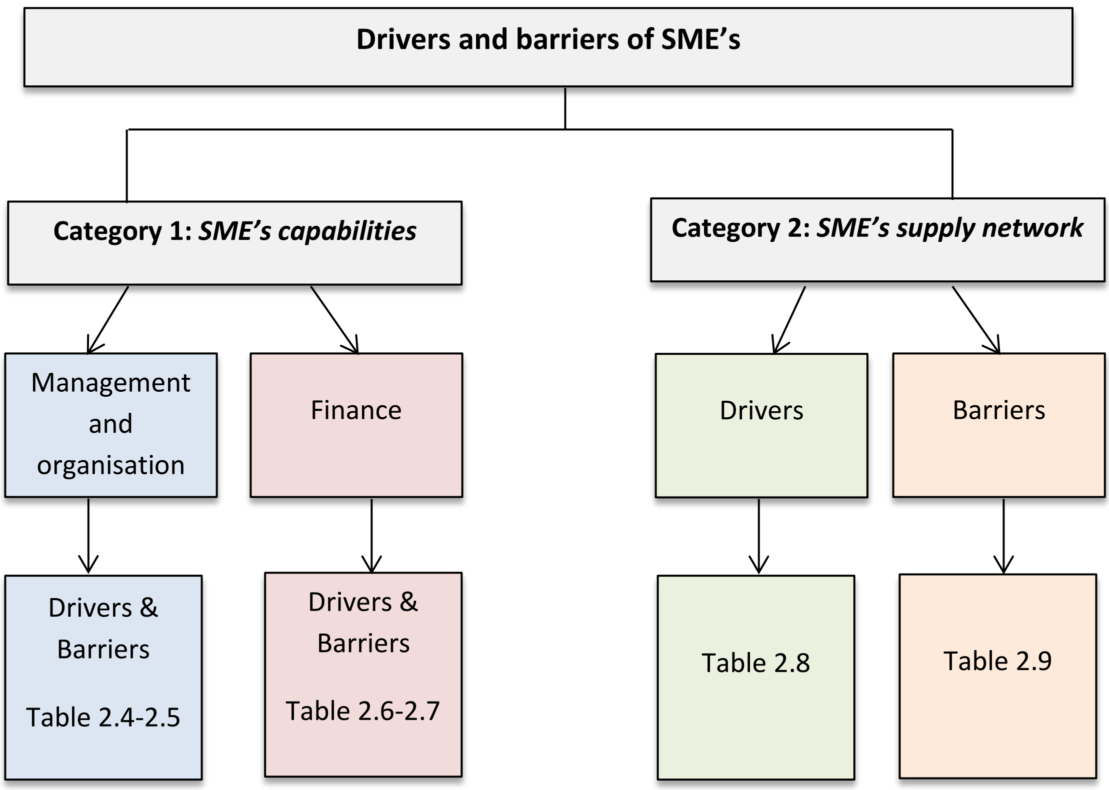


**Figure 2.9: Outline of discussion of Tables 2.4–2.9**

Tables 2.4 to 2.9 below reflect the drivers and barriers which influence SMEs' engagement towards environmental and sustainable initiatives from a management and organisational perspective. Table 2.4 reflects 11 important drivers that should be present in SMEs from a management and organisational perspective. It is important that top management should create a milieu where the environment is a priority. Top management must share their knowledge and expertise with lower-level management. The staff must be motivated to implement environmental activities such as green logistics practices.

**Table 2.4: Drivers that can enhance SMEs' engagement towards environmental and sustainable initiatives from a management and organisational perspective**

| **Category 1: SMEs' capabilities – management and organisation** | | |
|---|---|---|
| ***Drivers*** | ***Source*** | ***Country/Region*** |
| 1. Commitment and environmental championing by top management | Darnall, Jolley & Handfield, 2008<br>Lee, 2008 | USA<br>South Korea |
| 2. Values and beliefs of top management on environmental issues | Cambra-Fierro, Hart & Polo-Redondo, 2008 | Spain |
| 3. Existence of environmental awareness | Lee, 2008 | South Korea |
| 4. Response to stakeholders | Seuring & Müller, 2008 | Germany |
| 5. Teamwork and knowledge sharing between employees | Darnall *et al.,* 2008 | USA |
| 6. Skills and expertise of environmental management | Darnall *et al.,* 2008 | USA |
| 7. Increasing staff motivation of environmental practices | Baden, Harwood & Woodward, 2009 | United Kingdom (UK) |
| 8. Genuine concern and compassion of management about the welfare of employees | Baden *et al.,* 2009 | UK |
| 9. Managers who think holistically and who are interested in and knowledgeable about environmental issues | Williams & Schaefer, 2013 | East of England |
| 10. Personal/ethical/ecological values and beliefs | Williams & Schaefer, 2013 | East of England |
| 11. Traditional regulation regarding the environment | Lynch-Wood & Williamson, 2014 | UK |

**Source: Adapted from Meqdadi *et al.* (2013)**

Table 2.5 reflects 15 barriers that prevent SMEs' engagement towards environmental and sustainable initiatives from a management and organisational perspective. In some cases, the employees of SMEs can experience a low level of environmental awareness due to top management's lack of skills and technical proficiency. In many cases, environmental practices are viewed by top management as a financial burden and not as beneficial to the organisation.

**Table 2.5: Barriers that can prevent SMEs' engagement towards environmental and sustainable initiatives from a management and organisational perspective**

| **Category 1: SMEs' capabilities – management and organisation** | | |
|---|---|---|
| ***Barriers*** | ***Source*** | ***Country/Region*** |
| 1. SMEs are heterogeneous and operate in different contexts | Merrit, 1998 | London |
| 2. Suppliers' lack of information, resources and expertise | Wycherley, 1999 | UK |
| 3. Suppliers acting in self-interest | Wycherley, 1999 | UK |
| 4. Lack of human resources supporting environmental issues | Simpson, Taylor & Barker, 2004 | South Yorkshire |
| 5. SMEs' perception that their impact on the environment is minimal | Simpson *et al.,* 2004 | South Yorkshire |
| 6. Lack of management time to address green issues | Simpson *et al.,* 2004 | South Yorkshire |
| 7. Perception of environmental management as financial burden | Revell & Blackburn, 2007 | UK |
| 8. Perception of no benefits from improving environmental performance | Revell & Blackburn, 2007 | UK |
| 9. Lack of top management on environmental commitment | Revell & Blackburn, 2007 | UK |
| 10. Culture and attitude toward environment and change | Revell & Blackburn, 2007 | UK |
| 11. Lack of skills, know-how and technical expertise on environmental practices | Wooi & Zailani, 2010<br>Revell & Blackburn, 2007 | UK |
| 12. SME firm is family-orientated | Wooi & Zailani, 2010 | Malaysia |
| 13. Lack of environmental awareness | Wooi & Zailani, 2010 | Malaysia |
| 14. No instant economic benefits achieved from implementing green practices | Brammer *et al.,* 2012 | UK |
| 15. Lack of environmental technology | Earnhart *et al.,* 2014 | UK |

**Source: Adapted from Meqdadi *et al.* (2013)**

Table 2.6 and Table 2.7 reflect seven financial drivers and six barriers respectively of environmental initiatives. The lack of financial resources and unavailability of capital are the main issues SMEs are faced with, preventing them from implementing environmental initiatives. However, SMEs that adhere to environmental policies are benefiting in terms of cost savings and gain a competitive advantage in the market.

**Table 2.6: The financial drivers that can enhance SMEs' engagement in environmental and sustainable initiatives**

| **Category 1: SMEs' capabilities – finance** | | |
|---|---|---|
| ***Drivers*** | ***Source*** | ***Country*** |
| 1. Availability of infrastructure | Wycherley, 1999 | UK |
| 2. Fear of reputation loss | Seuring & Müller, 2008 | Germany |
| 3. Cost savings and economic benefit | Cambra-Fierro *et al.,* 2008 | Spain |
| 4. Availability of financial and technical resources | Lee, 2008 | South Korea |
| 5. Developing a competitive advantage by building a positive image on the market | Cambra-Fierro *et al.,* 2008 | Spain |
| 6. Complying with environmental standards for tendering purposes | Baden *et al.,* 2009 | UK |
| 7. Seeking competitive advantage and differentiation in the market | Baden *et al.,* 2009 | UK |

**Source: Adapted from Meqdadi *et al.* (2013)**

**Table 2.7: The financial barriers that can prevent SMEs' engagement in environmental and sustainable initiatives**

| **Category 1: SMEs' capabilities – finance** | | |
|---|---|---|
| ***Barriers*** | ***Source*** | ***Country*** |
| 1. Existing investments and information systems which are costly to change | Wycherley, 1999 | UK |
| 2. Uneconomical benefits of recycling activities | Min & Galle, 2001 | United States of America (USA) |
| 3. Unavailability of capital for investment in environmental initiatives | Hitchens, Clausen, Trainor, Keil & Thankappan, 2003 | UK, Republic of Ireland, Germany and Italy |
| 4. High cost of environmental programmes | Seuring & Müller 2008 | Germany |
| 5. Lack of financial resources for implementing sustainable initiatives | Lee 2008<br>Simpson *et al.*, 2004<br>Wooi & Zailani, 2010 | South Korea<br>South Yorkshire<br>Malaysia |
| 6. Access to finances | Earnheart, Khanna & Lyon, 2014 | Europe |

**Source: Adapted from Meqdadi *et al.* (2013)**

Table 2.8 and Table 2.9 reflect six supply network drivers and 11 barriers. SMEs are under pressure from customers and authorities to comply with environmental regulations. As government regulations become more stringent, pressure on SMEs will increase.

**Table 2.8: The supply network drivers that can enhance SMEs' engagement in environmental and sustainable initiatives**

| **Category 2: Supply network** | | |
|---|---|---|
| ***Drivers*** | ***Source*** | ***Country*** |
| 1. Trust in long-term relationships | Wycherley, 1999 | UK |
| 2. Responding to the environment and social pressure groups | Seuring & Müller, 2008 | Germany |
| 3. Responding to regulations, laws and local authority pressure | Seuring & Müller, 2008 | Germany |
| 4. Green supply chain practices of the customer | Lee, 2008 | South Korea |
| 5. Pressure from customers to implement sustainable initiatives | Darnall *et al.*, 2008; Lee, 2008 | USA, South Korea |
| 6. Responding to external pressure and economic arguments | Williams & Schaefer, 2013 | East of England |

**Source: Adapted from Meqdadi *et al.* (2013)**

**Table 2.9: The supply network barriers that can prevent SMEs' engagement in environmental and sustainable initiatives**

| **Category 2: Supply network** | | | |
|---|---|---|---|
| ***Barriers*** | | ***Source*** | ***Country*** |
| 1. | Improper communication between government and SMEs | Merrit, 1998 | London |
| 2. | Lack of governmental regulations | Wycherley, 1999 | UK |
| 3. | Mistrust and confidentiality between partners | Wycherley, 1999 | UK |
| 4. | Negative reaction from other actors in the supply chain | Wycherley, 1999 | UK |
| 5. | Lack of buyer and supplier awareness towards environment | Min & Galle, 2001 | USA |
| 6. | Lack of standards and auditing programmes | Min & Galle, 2001 | USA |
| 7. | Lack of supply chain pressure | Revell & Blackburn, 2007 | UK |
| 8. | Lack of awareness of existing environmental regulations | Revell & Blackburn, 2007 | UK |
| 9. | Insufficient or missing communication in the supply chain | Seuring & Müller, 2008 | Germany |
| 10. | Lack of bargaining power of SMEs | Zhu, Sarkis, Lai & Geng, 2008 | China |
| 11. | Poorly developed environmental and social regulations in emerging economies | Earnheart *et al.,* 2014 | Europe |

**Source: Adapted from Meqdadi *et al.* (2013)**

Finally, Meqdadi *et al.*'s (2013) findings and literature indicated that SMEs' behaviour towards the implementation of sustainable initiatives is complex, due to SMEs' unique patterns, actions, and approach. Baden *et al.* (2009) further argue that the primary driver for SMEs' approach towards the adoption of sustainable initiatives results fundamentally from internal drivers centred on moral and ethical beliefs, and not as many might think from external pressures.

In order to assist companies with the transformation process towards more sustainable organisations, Dunphy, Griffiths and Benn (2003) composed a useful framework, the *sustainability phase model* that expresses the six phases through which organisations go in order to achieve sustainability. The sustainability phase model is displayed in Figure 2.10 below.

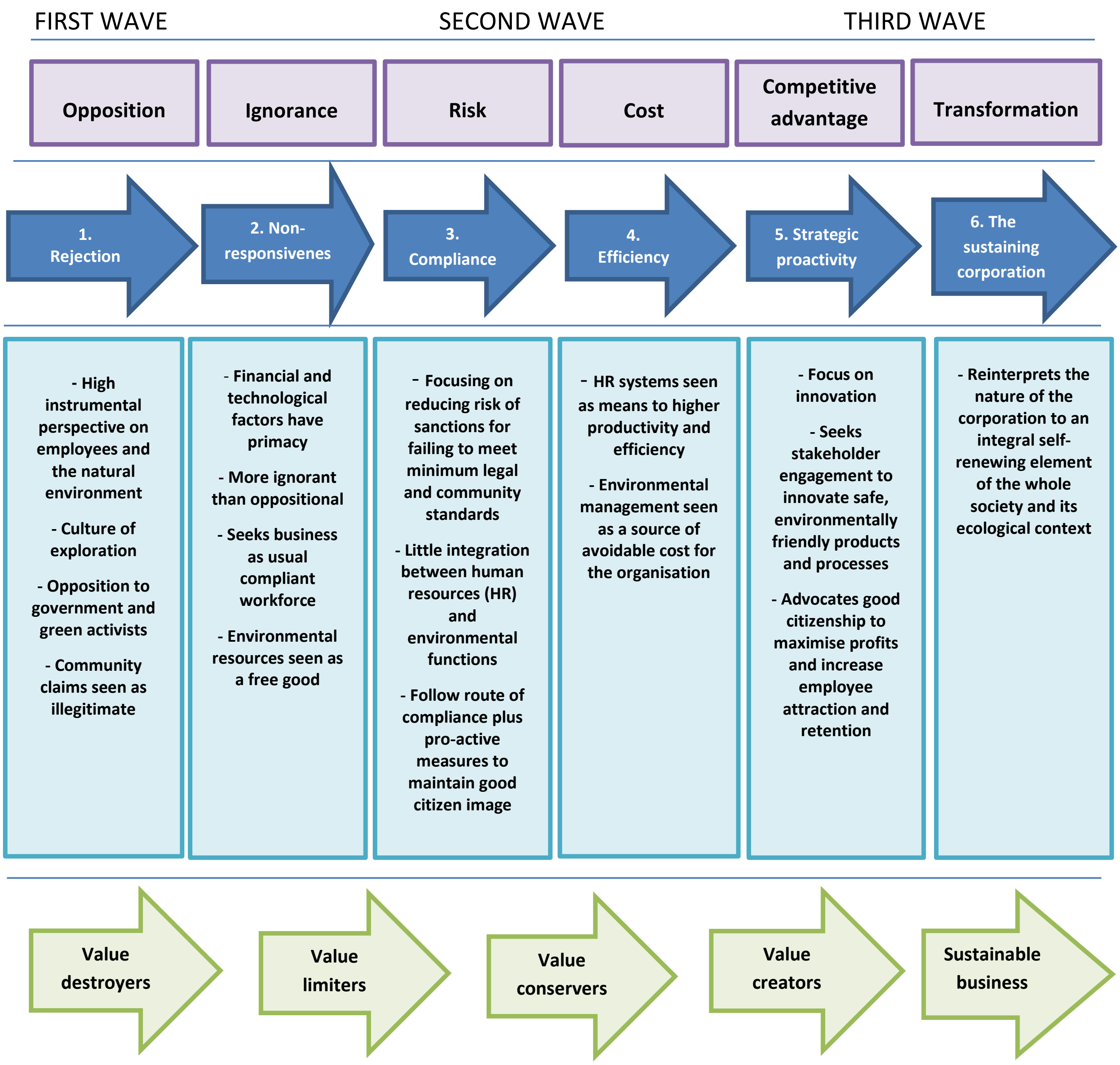


**Figure 2.10: The sustainability phase model**

**Source: Dunphy *et al.* (2003)**

This model represents a simplified framework which can be used across various organisations with simplified or complex organisational structures. At the top, the key words in the purple boxes above each arrow explain the main focus of senior management at that phase, namely opposition, ignorance, risk, cost, competitive advantage and transformation. The six phases are represented by the dark blue arrows, namely rejection, non-responsiveness, compliance, efficiency, strategic production and sustaining the organisation. The light blue rectangular blocks beneath each the dark blue arrows represent the attributes of the organisation currently at that phase. The second set of green arrows beneath the light blue rectangular blocks represents how each individual phase affects the value of the organisation, namely value destroyers, value limiters, value conservers, value creators, value creators and sustainable business. The six phases identified by Dunphy *et al*. (2003) will be briefly discussed below:

i. The first phase is *rejection*, where the senior executives are opposed to change. Companies that are currently in the rejection phase are opposed to government and green activism. They are exposed to a culture of exploration, and community claims are seen as illegitimate. There is a high instrumental perspective on employees and the natural environment.

ii. The second phase is *non-responsiveness*, where senior executives are ignorant about transformation. Companies that are in the non-responsive phase often see environmental resources as a free good, where financial and technological factors have primacy.

iii. The third phase is *compliance*, where senior executives are concerned with managing risk. Organisations in this phase are often characterised by maintaining a good citizen image by following pro-active measures and reducing risk complying to minimum legal and community standards. There is little integration between HR and environmental functions.

iv. The fourth phase is *efficiency*, where senior executives are concerned with managing cost. Organisations in this phase aim to achieve higher productivity and efficiency, and environmental management is seen as a source of avoidable cost for the organisation.

v. The fifth phase is *strategic pro-activity*, where senior executives are aiming to gain a competitive advantage. Organisations in the fifth phase are focused on innovation by seeking stakeholder engagement to innovate safe, environmentally friendly products and they promote good citizenship to maximise profits and improve employee attraction.

vi. The sixth phase is the *sustainable corporation*, where senior executives' main focus and business values is transformation. The nature of the corporation is revised with the society and environment as the main focus points.

Sloan *et al.* (2013) further claim that this model can help organisations establish exactly in which phase they currently are, and how to get towards the final phase of transformation.

The sustainability phase model will be used to establish in which phase of transformation SMEs and larger logistics and transport companies in Gauteng were at the time of this research, and which practices they should implement to reach phase 6 (see section 5.7.1.1).

Finally, organisations, regardless of their sustainability phase, are confronted with day-to-day logistics decisions that affect the environment. This will be discussed in section 2.5.

## 2.5 LOGISTICS DECISIONS THAT AFFECT THE ENVIRONMENT

In order to create a sustainable business environment, logistics managers of small and large companies are faced with important decisions to make regarding routine logistics activities that directly affect the environment. The link between logistics and the environment is rooted in the value-adding activities an organisation execute (Wu & Dunn, 1995). Making the correct decisions regarding logistics activities can potentially reduce the negative impact on the environment. Note that these decisions can be affected by other departments in the supply chain, such as the marketing and manufacturing department.

> *Integrative environmental management means that every element in the corporate value chain is involved in minimization of the firm's total environmental impact from start to finish of the supply chain and also from beginning to end of the product life cycle. Managers must reassess their logistics decisions in such a way that they can respond to impacts coming from other functions such as marketing and manufacturing and from external sources such as the government and the consumer* (Wu & Dunn, 1995:23).

Figure 2.11 reflects the daily decisions logistics managers are faced with that have an impact on the environment. It is the responsibility of the logistics managers to make sure the production and logistics strategies are sustainable in the long term. The authors (Wu & Dunn, 1995) identify two types of logistics approaches: Firstly, they refer to the traditional logistics system approaches which do not incorporate environmental concerns, and whose main aim is to minimise costs and maximise profits. Secondly, the alternative approach is an environmentally orientated logistics approach whose main objective is to minimise total environmental impact.

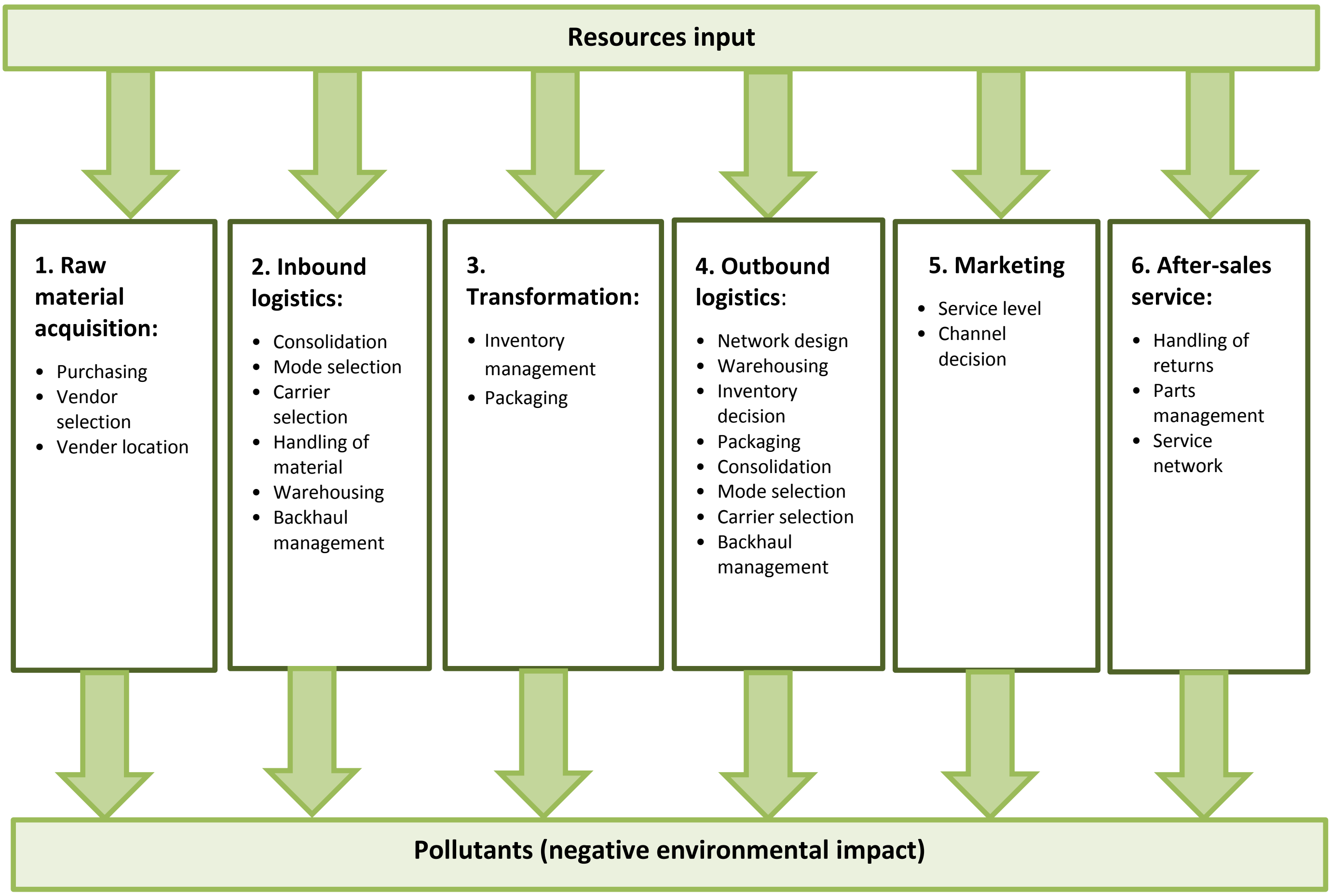


**Figure 2.11: Logistics decisions that affect the environment**

**Source: Wu and Dunn (1995:24)**

Each of the six different elements of logistics decisions, as reflected in figure 2.11, are discussed briefly in the sections below.

1) *Raw material acquisition*: Wu and Dunn (1995) describe raw material acquisition as the purchasing activities and logistical arrangements that bring the essential inputs to the organisation. The demand for environmentally friendly raw material is increasing as the demand for 'green products' rises. Purchasing managers will have to make sure their suppliers comply with the International Organisation for Standardisation's (ISO) 14000 standards. In 1998, the ISO 14000 was released. This document is globally accepted, and consists of guidelines for logistics managers to manage the environmental impact of their organisation (Bowersox *et al.*, 2013). Certified ISO 14000 suppliers conform to the environmental guidelines of the ISO.

2) *Inbound logistics:* This element refers to the receiving, storage and movement of raw materials from suppliers or vendors into production processes or storage facilities (Coyle, Bardi & Langley, 2003). Some of the decisions management are confronted with are: consolidation, mode selection, carrier selection, handling of material and warehousing and backhaul management.

3) *Transformation:* Transformation is the process of taking inputs and changing them into final products via assembly, testing and packaging activities. Inventory management and primary packaging are vital in the transformation process (Wu & Dunn, 1995).

4) *Outbound logistics:* This element refers to activities associated with the movement and storage of products from the end of the production line to the end consumer (Coyle *et al.*, 2003). Some of the decisions management are confronted with are: network design, warehousing, inventory decisions, packaging, consolidation, mode selection, carrier selection and backhaul management.

5) *Marketing:* The core concept of customer-focused marketing is ensuring the customer is the main focus of the organisation's strategy (Bowersox *et al.*, 2013). Logistics play a key role in the marketing concept by ensuring goods and services are delivered on the right place at the right time therefore adhering to customer requirements and needs.

6) *After-sales service:* Comprises handling of returns, parts management and the service network (Wu & Dunn, 1995).

Careful consideration should accompany decisions on how to execute daily value-adding activities, as these activities have the ability to reduce the negative environmental impact of pollutants.

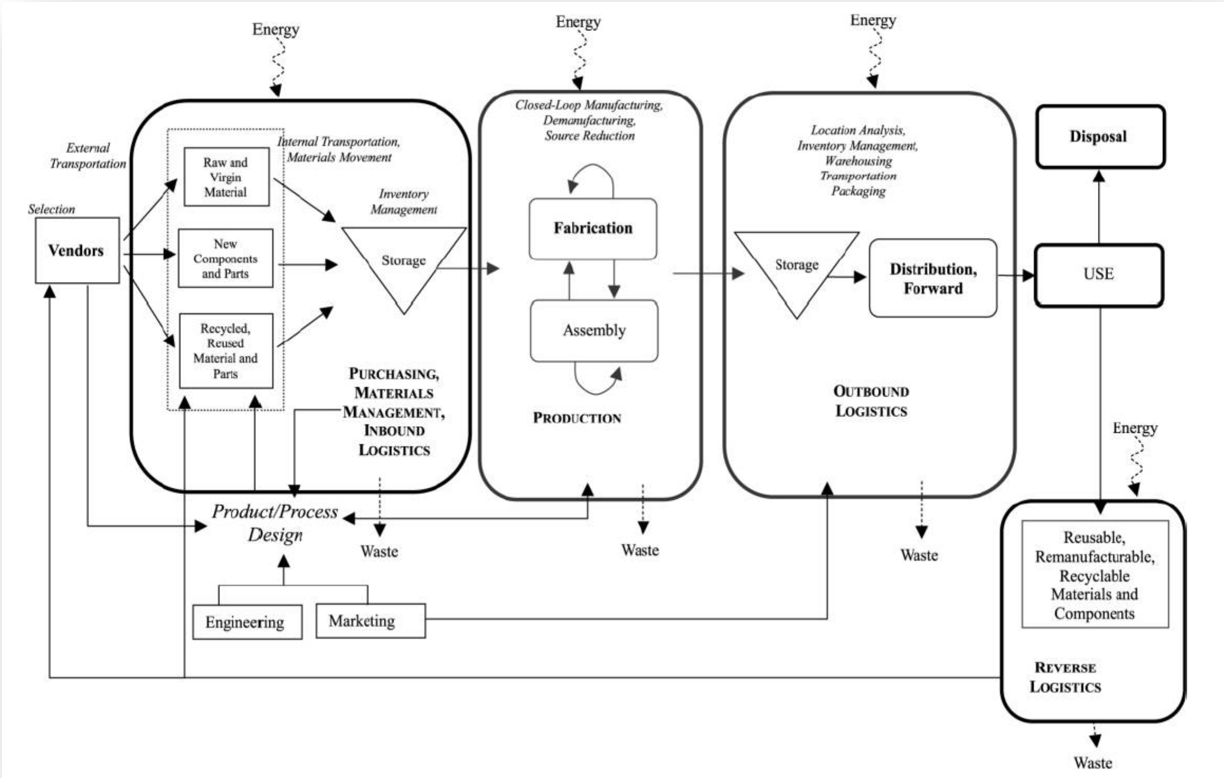


**Figure 2.12: Materials, product and information flow: forward and reverse logistics**

**Source: Sarkis *et al.* (2004:304)**

Figure 2.12 depicts four logistics activities within the supply chain, with special attention to ecological initiatives.

i. Figure 2.12 starts by introducing *procurement* and *inbound logistics activities*, where the purchasing of raw material from selected vendors plays a critical role. Procedures for selecting various vendors, transportation and delivery services are some of the main problems purchasers have to deal with. These materials will be stored, followed by the design of the products and processes, where environmental awareness plays a critical role.

ii. Production, which includes two main functions namely *fabrication* and *assembly*, is the second activity. Closed-loop manufacturing, de-manufacturing and source reduction are some of the factors that make a contribution towards reducing the environmental impact of production.

iii. The third activity is *outbound logistics*, which include the following activities: warehousing, transportation, packaging, location analysis and inventory management. Each activity consumes energy and generates waste.

iv. The last activity refers to when the product/service is used or sent back via the supply chain to the producer through the *reverse logistics* channel. This product may be reusable, recyclable or re-manufacturable (Sarkis, Meade & Talluri, 2004).

Therefore, figure 2.11 and figure 2.12 illustrate the influence of logistics decisions and activities on the environment, and the importance of selecting sustainable activities which can possibly reduce the negative impact on the environment.

Section 2.6 focuses on green logistics initiatives implemented by South African companies and various green initiatives implemented by overseas cities (such as London, Paris, Copenhagen, New York and Vancouver) to reduce the environmental impact.

## 2.6 GREEN LOGISTICS INITIATIVES IMPLEMENTED BY SOUTH AFRICAN COMPANIES

This section reports on practical examples of green logistics initiatives implemented amongst others by South African (SA) companies, as well as green practices implemented by various international countries.

### 2.6.1 Retailer – Woolworths

In South Africa, Woolworths, a retail company and supporter of green logistics practices is testing nitrogen-refrigerated trucks to reduce noise levels as well as carbon emissions.

> *Woolworths says the ecoFridge can accurately maintain multiple temperature zones in one truck, which allows it to transport products that may need to be stored at different temperatures in one vehicle. It is also said to be 70% to 80% faster than mechanical systems in reducing the temperature to the required level, with the drop from 30 °C–18 °C achieved in less than 40 minutes* (Venter, 2010).

### 2.6.2 Vehicle manufacturers – Volkswagen and Nissan

In the motor industry, vehicle manufacturers – such as Volkswagen and Nissan – are currently launching exciting new projects in order to promote green initiatives and set themselves apart from their competitors. Volkswagen South Africa has embraced a three-pronged approach by introducing the Think Blue idea to South African consumers, namely BlueFactory (Van Wie, 2012), BlueMotion (Think blue, 2015) and BlueEnvironment. Think Blue deals with how individual mobility and sustainability can be harmonised, and functions as an umbrella brand for Volkswagen's activities relating to environmental sustainability (Gray, 2013).

Nissan South Africa has entered into collaboration with the Department of Environmental Affairs, including a pilot project that will be a prototype to the launch into the local market of the Nissan Leaf, the original mass-produced electric vehicle (Cokayne, 2013). These are only two of the many initiatives large companies are introducing in order to reduce carbon emissions.

### 2.6.3 Banking – Standard Bank

According to the head of Fleet Management at Standard Bank, Dr Molapo, the introduction of legislation for a carbon tax on vehicles indicates the beginning of upcoming industry changes. These will play a part in minimising greenhouse emissions in South Africa and associating the country with global best practices (Staff Reporter, 2013).

However, in response to the expected rising demand for information about vehicle emissions and carbon footprints, Standard Bank announced a sophisticated online measurement tool, $ECO_2$ Fleet (Standard Bank, 2011). $ECO_2$ Fleet estimates the size of a fleet's carbon footprint, the total of carbon dioxide discharged by the vehicles into the atmosphere, and depicts the data in a publishable format, ready for inclusion in a business report or an environmental impact assessment (Staff Reporter, 2013).

### 2.6.4 Service provider – Pikitup

Pikitup is the City of Johannesburg's official waste management service provider and has recently purchased a new fleet, consisting of 20 compactors and 11 street-cleaning trucks worth R49.2 million rand (Ntshingila, 2013). These trucks meet the terms of the latest Euro 3 emission standards. Mfikoe, member of Johannesburg's mayoral committee responsible for the environment, infrastructure and services stated that Pikitup is aware of the importance of reducing pollution and decreasing the amount of carbon footprint (Ntshingila, 2013).

Logistics companies are fully aware that 'greening' their supply chain benefits their people and profits, but most important of all, the planet. The concept of sustainability is a fresh topic among competing firms.

### 2.6.5 Imperial Logistics

The third annual Green Supply Chain Awards ceremony took place in 2011, and the esteemed Industry leader Award was presented to De Swardt, Marketing Director of Imperial Logistics (Vantage Capital, 2011). "Imperial Logistics is on a sustainability focused growth path that balances people, planet and profit – a factor that contributes to the Group being a leading global logistics and supply chain player" (Imperial Logistics, 2011). This statement makes it clear that, in order for logistic companies to become a key competitor in their industry as well as globally, logistic enterprises must manage their TBL accordingly while implementing green logistic practices. From these practical South African examples, it is clear that companies are taking action in terms of green practices and striving towards sustainability.

Table 2.10 provides examples of green logistics initiatives that several overseas cities, namely London, Paris, Copenhagen, New York, Vancouver, etc. are currently implementing.

**Table 2.10: Green logistics schemes overseas cities are implementing**

| Type of green scheme | Policy |
|---|---|
| **Charging** | • London – congestion charging<br>• Germany – truck toll system |
| **Clean vehicles** | • Rotterdam – electric vehicle city distribution system<br>• Osaka – electric vans<br>• Zurich – cargo trams |
| **Congestion mitigation** | • Barcelona – multiple use lanes and online parking information<br>• Paris, Barcelona<br>• Rome – night delivery schemes |
| **Coordinated transport** | • Berlin – goods traffic platform<br>• Stockholm – logistical centre for coordinated transports |
| **Information systems** | • New York and Vancouver – internet port information system<br>• Tokyo – advanced information system |
| **Restriction zones** | • Copenhagen – city goods ordinance management<br>• Sweden – environmental zones<br>• UK – low-emissions zones<br>• Brussels – lorry-dedicated routes |
| **Water use** | • Amsterdam – floating distribution centre<br>• Amsterdam- Waterborne traffic management decision support system |

**Source: Jumadi and Zailani (2010:262)**

These countries have advanced systems in place in order to improve air quality, reduce noise and carbon emissions. These systems aim to decrease the environmental impact and externalities of various transport modes. The next section focuses on the paradoxes of green logistics and the discrepancies that exist between the environment and green logistics initiatives.

## 2.7 PARADOXES OF GREEN LOGISTICS

The term *externality* refers to the broader impact of logistics activities on the environment, community and ecosystem, which is not costed and excluded from a company's financial reports (McKinnon *et al.*, 2010). Although logistics activities damage the environment, which has major cost implications, a monetary value cannot always be linked to the environmental damage done. Rodrigue, Slack and Comtois (2001) investigate this topic by addressing the paradoxes of green logistics.

The authors (Rodrigue *et al*. 2001) indicate that it will take some time before the environment will be treated as a main concern in the logistics industry, and raised this important question that led to the investigation of the paradoxes of green logistics: "Are the achievements of transport logistics compatible with the environment?" (Rodrigue *et al*. 2001:3)

The six dimensions of logistics (see Table 2.11) were investigated to identify the discrepancies between the logistics industry and the environment. These paradoxes are summarised on the next page in Table 2.11.

**Table 2.11: The paradoxes of green logistics**

| Dimension | Outcome | Paradox |
|---|---|---|
| **1. Costs** | Reduction of costs through improvement in packaging and reduction of wastes. Benefits are derived by the distributors. | Environmental costs are often externalised. |
| **2. Network** | Increasing system-wide efficiency of the distribution system through network changes (hub-and-spoke structure). | Concentration of environmental impacts next to major hubs and along corridors. Pressure on local communities. |
| **3. Time/Flexibility** | Integrated supply chains. Just-in-time (JIT) and door-to-door (DTD) methods provide flexible and efficient physical distribution systems. | Extended production, distribution and retailing structures consuming more space, more energy and producing more emissions ($CO_2$, particulates, NOx, etc.). |
| **4. Reliability** | Reliable and on-time distribution of freight and passengers. | Modes used, trucking and air transportation are environmentally least efficient. |
| **5. Warehousing** | Reducing the needs for private warehousing facilities. | Inventory shifted in part to public roads (or in containers), contributing to congestion and space consumption. |
| **6. E-commerce** | Increased business opportunities and diversification of the supply chains. | Changes in physical distribution system towards higher levels of energy consumption. |

**Source: Rodrigue *et al.* (2001:7)**

The authors Tambovcevs and Tambovceva (n.d) elaborate further on the conflicts or paradoxes that these elements of green logistics present:

- *Costs*: The main aim of most transport and logistics companies is to minimise transportation and logistics costs and to maximise profit. Sometimes these cost saving initiatives can clash with environmental concerns. The paradox is that, although logistics costs can be reduced by certain strategies like improvement in packaging and reduction in waste, the environment takes up a lot of these burdens and costs, meaning that environmental costs are often externalised.

- *Network*: The hub-and-spoke network (Rodrigue *et al.,* 2001) reflect the restructuring of the transportation networks over the last few decades, and focuses mainly on air, rail and maritime transportation. Cost savings are achieved by the joining of freight and passengers at hubs. There is a strong focus point of traffic at a small number of terminals, which results in environmental issues such as congestion, noise and air pollution (Rodrigue *et al.*, 2001).

Figure 2.13 illustrates the hub-and-spoke network and the environment.

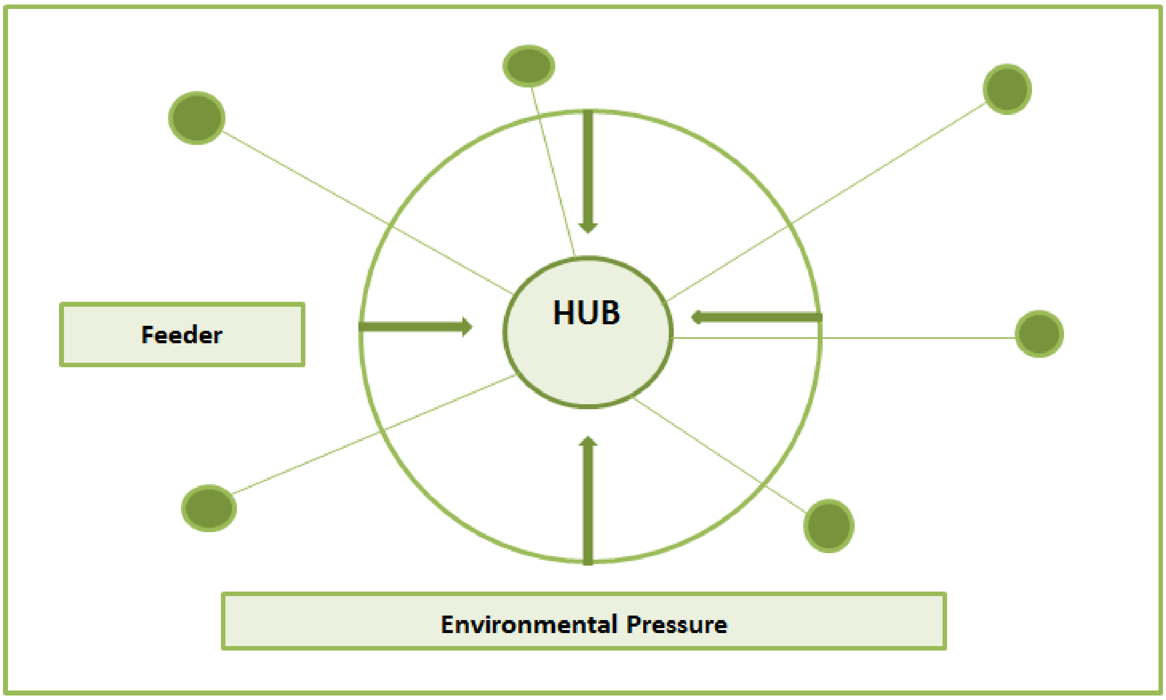


**Figure 2.13: Hub-and-spoke network and the environment**
**Source: Rodrigue *et al.* (2001:4)**

- *Time/Flexibility*: The popular saying in the business environment 'time is money' applies to many companies striving to achieve maximum service delivery and profit. In logistics, using the fastest mode of transport might not be the most energy-efficient and environmentally friendly option available. Air and road freight transport is among the most popular modes of transport to achieve the widely used JIT strategies and DTD services (Tambovcevs & Tambovceva, n.d).

- *Reliability*: Service reliability is an essential component for customer satisfaction. The most reliable mode of transport might not be the most environmentally friendly method (Tambovcevs & Tambovceva, n.d). The most polluting modes are also the most reliable modes, namely road and air transport, while the least polluting modes, namely railways, pipelines and ships are seen as the least reliable when taking into consideration damage and on-time delivery.

- *Warehousing*: Currently, the demand for warehousing seems to be declining, as more companies are implementing JIT and DTD principles and less stock requires storage. Therefore, more inventories are transported by road, contributing to more pollution and congestion (Tambovcevs & Tambovceva, n.d).

- *E-Commerce*: Technology and information systems are enabling increased business opportunities and diversified supply chains. The paradox of e-commerce relates to the positive effects against higher levels of energy consumption due to changes in the physical distribution system (Rodrigue *et al.,* 2001).

These six dimensions illustrate that, in order to reduce logistics costs, environmental costs are often being externalised. Many practices are put in place to reduce logistics costs, and usually there is an environmental cost involved in implementing these practices. The result is that the environment ends up 'paying' for the reduction in total logistics cost. Management should carefully consider the daily logistics decisions being made not to affect the environment negatively in order to save on business costs. The *environment* should be a key priority when making logistics decision.

## 2.8 CONCLUSION

Chapter 2 highlighted some of the important issues regarding green logistics, logistics costs, sustainability, environmental decision-making and the paradoxes of green logistics.

Section 2.1 introduced the concepts of green logistics and sustainability. Section 2.2 provided an overview of the main cost components of logistics costs in South Africa. Logistics costs can be divided into three direct elements, namely transport, storage and handling costs, management and administration costs and one indirect element, namely inventory-carrying costs. It was found that there is a positive link between the provincial logistics capability (PLC) of a province and the provincial economy. The Western Cape has the highest logistics costs as well as transportation costs. Gauteng has the second highest transport costs and the highest inventory carrying cost; Mpumalanga is ranked third after the Western Cape and Gauteng, with the third highest transport costs followed by KwaZulu-Natal, Eastern Cape, Limpopo, Northern Cape, Free State and North West.

The top three provinces that contribute the most to South Africa's economy, namely Gauteng, KwaZulu-Natal and the Western Cape, are the provinces with the best road infrastructure in South Africa (see figure 2.3). Ten key objectives and constraints were identified by the respondents in the Barloworld Logistics Survey (2014). The main issue regarding high freight volumes being transported by road and not rail and the impact on the environment and deteriorating road conditions were highlighted and discussed in Table 2.1 and Table 2.2.

Section 2.3 addressed the dimensions of sustainability and green logistics. In this section, the meanings of sustainability and SSCM were discussed. Three dimensions of sustainability were identified, namely economic, environmental and social sustainability. Economic sustainability emphasises that logistics and transport firms must constantly attempt to reduce their total supply chain costs through balancing sustainable and strategic initiatives (Bowersox *et al.*, 2013). Van Marrewijk (2003) broadly defines CSR as firms displaying environmental and social concerns in business operations including interactions with stakeholders. Environmental sustainability can be further subdivided into three sections namely conservation, usage reduction and business management practices (Bowersox *et al.*, 2013). The concept of transport system sustainability was also discussed.

Section 2.4.1 introduced SMEs' adoption towards environmental initiatives. Section 2.4.2 identified nine aspects, which influence the development of SMEs' environmental strategies. The nine aspects are financial resources, organisational structure, management style, human resources, environmental management status, manufacturing activity, technological approach, innovative capacity, and external cooperation.

In section 2.4.3, the drivers and barriers, which influence SMEs to take part in environmental and sustainable initiatives were grouped into two categories. The first category was SMEs' capabilities and the second category was SMEs' supply network. The first category, SMEs' capabilities, reflected how management and the organisation play an important role in encouraging environmental behaviour. Finance is also included in this group. The second category, SMEs' supply network, referred to the external factors that play a role, such as pressure from customers, laws and regulations. These drivers and barriers are summarised in Tables 2.4 to 2.9.

In order to assist companies with the transformation process towards more sustainable organisations, Dunphy *et al.* (2003) composed a useful framework, the sustainability phase model that expresses the six phases through which organisations have to go in order to achieve sustainability. The sustainability phase model is displayed in Figure 2.10, and the six phases, namely rejection, non-responsiveness, compliance, efficiency, strategic proactivity and the sustaining corporation were discussed in detail.

Section 2.5 addressed logistics decisions that affect the environment. In this section, six elements were identified and discussed, namely raw material acquisition, inbound logistics transformation, outbound logistics, marketing and after-sales service. Section 2.6 discussed green logistics initiatives implemented in SA companies. In this section, certain companies from different industries were identified and their green initiatives were discussed. These companies included Woolworths, Volkswagen, Nissan, Standard Bank, Imperial Logistics and the service provider Pikitup. Various green logistics initiatives implemented globally were summarised in Table 2.10.

In section 2.7, the externalities and paradoxes of green logistics were identified and discussed. Six dimensions were investigated to identify the discrepancies between the logistics industry and the environment. These six dimensions were costs, network, time, reliability, warehousing and e-commerce.

From this chapter it is clear that most international firms are prioritising the implementation of the TBL concept by integrating the economic, environmental and social environment in order to move towards a more sustainable organisation. Although larger companies are moving towards more sustainable decision-making, SMEs are constantly confronted with external and internal pressure to engage in environmental initiatives (see section 2.4 ).

In conclusion, sustainability has traditionally been seen as a cost to most firms, but recent thinking showed that more businesses gain several advantages and profits from implementing environmentally sustainable practices resulting in long-term benefits for these businesses. Small and medium-sized firms should be encouraged to engage in these activities in order for them to be more sustainable and to benefit from the advantages.

One of the objectives of this study was to identify green practices or activities which logistic and transport companies in South Africa can implement in order to gain economic benefits and to transform towards a more sustainable environment. These practices not only influence the economy and the environment positively, but also strive to meet the social needs of the business environment.

Green logistics is gaining global attention, encouraged by existing production and distribution logistics strategies which are not sustainable in the long term (Lin, Choy, Ho, Chung & Lam, 2014). Therefore, it is very important that logistics companies identify green practices that can be implemented in order to achieve sustainability. The next chapter focuses on green logistics practices implemented globally at various hierarchical levels of a company. The drivers, barriers and benefits of green logistics practices are also identified and discussed.

# CHAPTER 3

# DRIVERS, BARRIERS AND BENEFITS OF GLOBAL GREEN LOGISTICS PRACTICES

## 3.1 INTRODUCTION

As mentioned in Chapter 2, the increasing amount of greenhouse gas emissions is a top environmental concern and most companies, especially in the transport and logistics industry, are looking for ways to counteract the damage caused by logistics activities. Green logistics entails the incorporation of environmental facets in logistics activities (Dekker, Bloemhof & Mallidis, 2011). "Consequently, the implementation of green practices into logistics systems is gaining worldwide importance" (Thiell *et al.*, 2011:334). The chapter will be discussed with reference to the flow diagram in Figure 3.1 below.

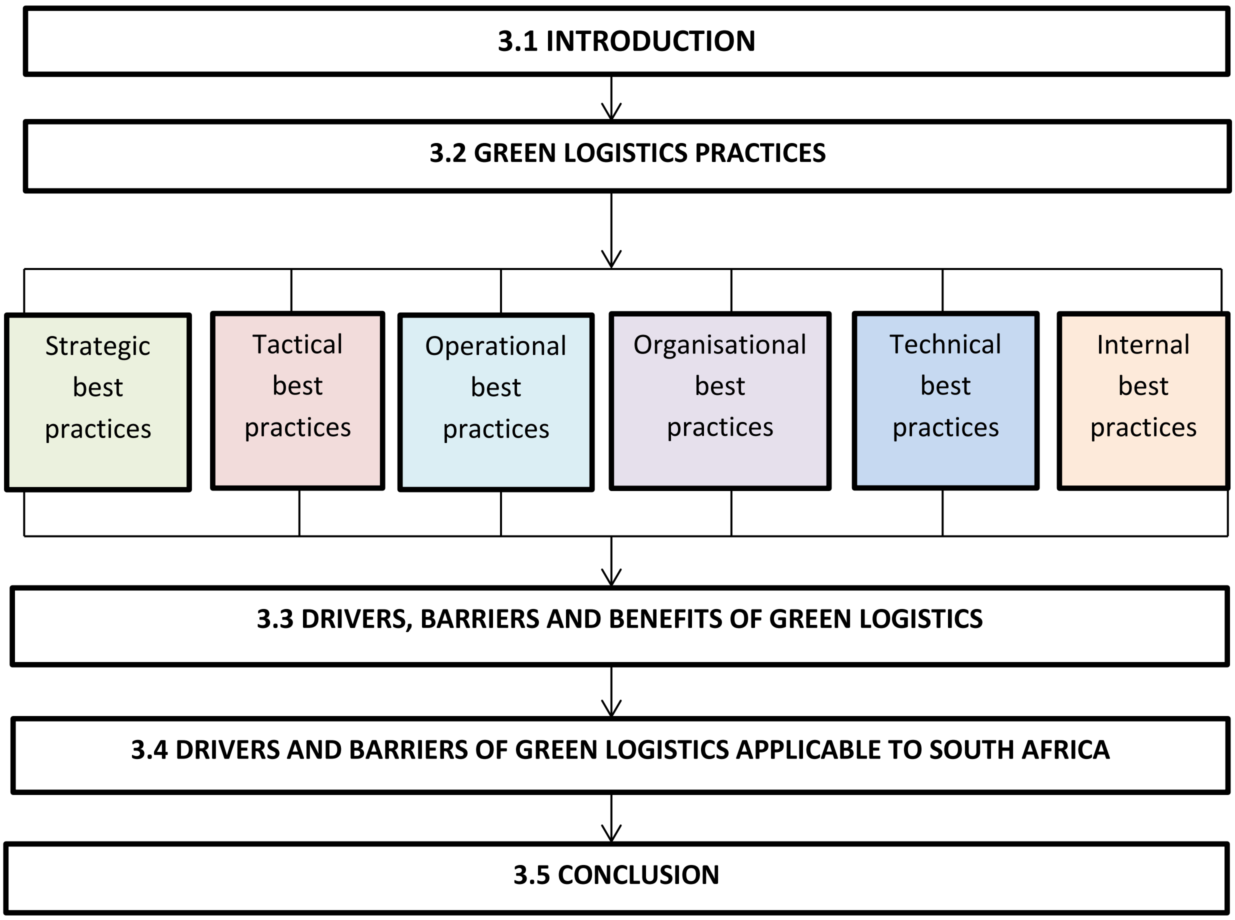


**Figure 3.1: Flow diagram of Chapter 3**

Section 3.2 reports on important green practices that can be implemented by transport and logistics companies in green logistics. These practices are subdivided into three groups: transportation, warehousing and value-added services.

These practices are summarised in Table 3.1, a matrix developed by Thiell *et al.* (2011), which will serve as a basic framework for further investigation into the implementation of green practices on the different hierarchical levels of a logistics company. This includes strategic, tactical and operational best practices.

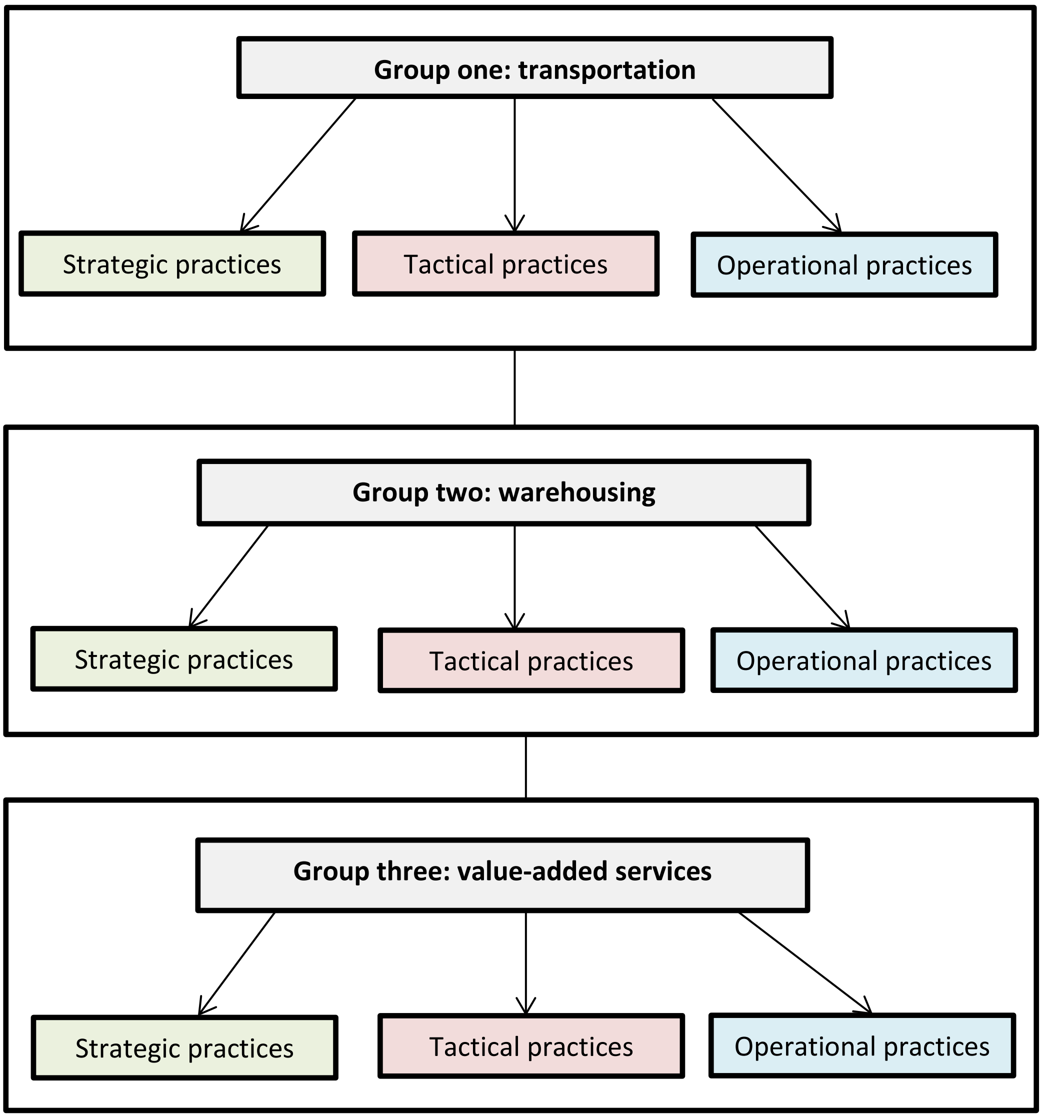


**Figure 3.2: Layout of discussion of Table 3.1**

## 3.2 GREEN LOGISTICS PRACTICES

Section 3.2 addresses the fourth secondary objective of the study, namely to *explore green logistics practices of logistics and transport companies located in Gauteng.*

### 3.2.1 Discussion of strategic, tactical and operational practices

**Table 3.1: Green logistics practices matrix**

| Green practise | Strategic practices | Tactical practices | Operational practices |
|---|---|---|---|
| **Group one: Transportation** | • Change of truck fleets<br>• Standardisation of truck sizes<br>• Creation of distribution centres<br>• Sustainable carrier selection | • Palletisation of cargo<br>• Freight consolidation<br>• Reuse of pallets and containers<br>• Modal choice | • Carbon footprint assessment<br>• Clean vehicles<br>• Fuel efficiency<br>• Load optimisation |
| **Group two: Warehousing** | • Automatic warehousing systems<br>• Facility design and construction | • Selection of different equipment<br>• Reconditioning and reuse of pallets and containers<br>• Disposition of products | • Clean material handling equipment<br>• Fuel efficiency<br>• Energy efficiency<br>• Process optimisation<br>• Minimisation of inventories<br>• On-site recycling |
| **Group three: Value-added Services** | • Carbon footprint assessment<br>• Gathering of green customer criteria<br>• Introduction of tracking and tracing systems | • Environmental certifications<br>• Pallet and container pooling systems<br>• Use of different packaging technologies and materials to reduce contamination | • Environmental footprint reports<br>• Use of tracking and tracing systems to improve performance of operations |

**Source: Thiell *et al.* (2011:344)**

The rows in Table 3.1 summarise the three main groups, namely transportation, warehousing and value-added services subdivided according to the hierarchical level within a logistics and supply chain enterprise represented by the strategic, tactical and operational levels.

– **Group one: Transportation**

Transportation is one of the main aspects of the supply chain that affect the environment, and produces various carbon emissions such as $NO_2$, $SO_2$ and PM[7] (Dekker *et al.*, 2011). The following green transportation practices as listed in Table 3.1 are discussed briefly below:

- *Change of truck fleets and the standardisation of truck sizes* – standardisation promotes the optimisation of freight and intermodal transportation. Changing of truck fleets can be difficult due to many organisations outsourcing trucking services (Thiell *et al.,* 2011).

- *Freight consolidation and creation of distribution centres (DCs)* – the creation of DCs brings about an optimal solution for consolidating freight operations. The layout of DCs can be adjusted to be more environmental friendly. Examples are reducing forklift trips, installing light-emitting diode (LED) lighting technologies, installing windows for more natural lights and installing solar panels (Thiell *et al.,* 2011).

- *Sustainable carrier selection* – this entails selecting carriers that incorporate environmental practices in the services they provide. Many companies choose to outsource their logistics services. Incorporating sustainable measures when selecting these carriers is important (Thiell *et al.,* 2011).

- *Palletisation of cargo and reuse of pallets and containers* – one of the main ways to recycle is to reuse pallets and containers. Plastic pallets can be used instead of traditional wooden pallets (Thiell *et al.,* 2011).

- *Modal choice* – this is one of the main green practices of logistics as identified by Carter and Jennings (2000). Modal choices in transportation usually consist of the following: transport by road, rail, plane, ship and pipelines. Each mode of transport affects the environment on a different scale. As mentioned in section 2.2, a large percentage of freight in South Africa is distributed by road, contributing to

[7] particular matter of fine dust

deteriorating road conditions and damaged freight (Viljoen, 2014). Therefore, a modal shift towards a more environment friendly modal choice, such as railway transport, must take place.

- *Carbon footprint assessment* – according to Gao, Liu and Wang (2013) and proposed by Wiedmann *et al.* (2010), carbon footprint is a measure of carbon dioxide emissions caused by performing activities or producing products. The concept of carbon footprint was derived from the concept of ecological footprint, which estimates human demand of the earth's ecological system (Gao *et al.*, 2013).

- *Fuel efficiency and clean vehicles* – the concept of clean vehicles includes various aspects such as increasing fuel efficiency to reduce oil use, increasing the use of biofuel and purchasing hybrid and electric cars (Thiell *et al.,* 2011).

- *Load optimisation* – this entails the optimum usage of space during transportation. There are various ways organisations can achieve efficient loading. Packaging can be custom designed to save costs and be environmentally more friendly, big loads can be consolidated into smaller packages, loading times can be adjusted according to off-peak transport times (Thiell *et al.,* 2011).

NFI is an international logistics firm providing transportation, warehousing and distribution services (NFI, n.d) and recently published a white paper on building environmentally responsible supply chains, and identified the following practices that can be implemented to achieve more sustainable transportation practices:

- *Alternative power sources* – this would enable conserving fuel in terms of driving and overall fuel usage. These alternative power sources include auxiliary power units (APUs) and refrigerated trailers. APUs regulate the temperature of driving cabins while not idling, and can be operated on battery power, which prevents fuel usage when the truck is not moving. Refrigerated trailers with electric stand-in and tractor additions can also be used as an alternative power source (NFI, n.d).

- *Ensuring proper maintenance* – automatic inflation systems can be installed to regulate tyre pressure and to inflate each tyre to a preferred pre-set tyre pressure as needed. This assists truck drivers with better handling on the roads (NFI, n.d).

- *Aerodynamics and equipment enhancements* – a trailer skirt can be attached underneath a trailer between the landing gear and the rear tyres, in order to refract wind and enhance the aerodynamics of the trailer, to achieve the desired speed without much work (NFI, n.d).

- *Trailer gap optimisation* can be achieved by tightening the gap between the cab and the trailer in order to reduce drag and improve fuel economy (NFI, n.d).

- *Improvement of mechanical and physical equipment* – if a truck idles too long, fuel is wasted and carbon emissions are increased. Trucks can be pre-set to switch off if they are idling too long. Drivers should be informed about the negative effects of idling, and proper training should be provided to the drivers to improve driving habits (NFI, n.d).

- *Intermodal transportation* – introducing refrigerated containers into the intermodal transport system made a significant difference to the logistics industry and created various opportunities to enable the shipment of frozen and temperature-controlled goods to other markets (NFI, n.d).

NFI predicts that the future of sustainable transportation lies in alternative fuels and power sources such as natural gas and solar power to reduce the amount of carbon footprint generated by transport activities.

– **Group two: Warehousing**

Introducing measures to save energy is gaining attention by companies aiming to reduce costs. There are various ways to save energy within warehousing, some more costly than others. Some of these measures are discussed below:

- *Automatic warehousing systems* – technologies used to streamline processes within the warehouse, for example automatic storage and retrieval systems that optimise the flow and timing within the warehouse (Thiell *et al.,* 2011).

- *Facility design and construction* – the layout and construction of warehouses directly influence the level of energy used to conduct operational activities. Several green practices can be used to 'green' warehouses: going paperless, installing LED lighting, painting walls white and installing more windows for natural light. Installing solar panels and warming systems, training operators to maximise fuel efficiency (Thiell *et al.,* 2011).

- *Reconditioning and reuse of pallets and containers* as mentioned above, plastic pallets can be easier recycled than wooden pallets, because they are lighter and can consist of recyclable material.

- *Disposing of products and on-site recycling* – this entails using more environmentally friendly ways of disposing of damaged or returned products. Products can be disposed of more easily if they are correctly packaged. 'Green packaging' is also known as 'ecological packaging' or 'environmentally friendly packaging' and can be used to recycle or reuse products more easily and does not harm the environment during the product's life cycle (Zhang & Zhao, 2012).

- *Clean material handling equipment and selection of different equipment* – this entails choosing more sustainable handling equipment within the environment. Forklifts are one of the main types of handling equipment within a warehouse. Diesel forklifts can be changed for electric forklifts, or biofuel can be used (Thiell *et al.,* 2011).

- *Minimisation of inventories* – a popular system used for the minimisation of inventory is the JIT system. The main idea of the JIT system is to eliminate reserve stock by timing the arrival of purchased materials just in time for the transformation process (Bowersox *et al.*, 2013). The materials can be raw materials or work-in-process inventories.

The following practices were also identified by the NFI (n.d) for implementation to achieve more sustainable warehousing:

- *Fluorescent bulbs* – these bulbs have an extended lifetime and provide brighter light consuming less energy. They generate less heat, which could possibly reduce air-conditioning costs and improve safety (NFI, n.d).

- *Motion sensor lighting* – this can be installed throughout various sections of the warehouse so that lights turn on when the staff is operating in a certain area and turned off when they exit the area (NFI, n.d).

- *LED lighting* – this type of lighting has an extended lifetime and provides brighter light consuming less energy (NFI, n.d).

- *Proper air circulation* – this can be enhanced by using fans strategically to enhance climate control and encourage a healthier working environment for staff (NFI, n.d).

- *Upgraded power sources* – by upgrading power sources in the warehouse, energy savings can be accomplished and equipment such as forklifts and pallet jacks can operate longer (NFI, n.d).

Warehouses should aim to move towards a paperless environment, where recycling is a top priority and packaging needs are reconsidered. According to NFI, the future of sustainable warehousing lies in the design and space utilisation of the building, and moving towards wind and solar power to eliminate traditional power generation.

– **Group three: Value-added services**

Outsourcing transportation services remains an important factor in the supply chain industry. Value-added-services delivered by carriers or third-party logistics service providers can promote the environmental provisions of companies by helping them regulate their direct logistic flow (Thiell *et al.*, 2011). The following value-added services as listed in Table 3.1 are discussed briefly below:

- *Environmental footprint reports and certifications* – the ISO established a set of standards accepted by companies globally. The ISO14000 was released in 1998 and deals with the environmental standards and guidelines of companies (Bowersox *et al.*, 2013). Companies adhering to environmental standards can apply to receive an ISO14000 certificate.

- *Green customer criteria gathering* – customers currently using large logistics firms may decide to use 'green criteria' whereby logistics service providers will only be chosen if they conform to green standards, or have an environmental compliance certificate like the ISO14000 (Thiell *et al.,* 2011).

- *Introduction of tracking and tracing systems* – various technologies or systems are available to companies to improve the efficiency of their daily operations such as enterprise resource planning (ERP) and radio frequency identification (RFID). RFID helps companies to recognise products and track damages through radio frequency (RF) waves (Ramanathan, Ramanathan & Lorraine Ko, 2014).

- *Use of different packaging technologies and materials to reduce contamination* – packaging products in eco-friendly materials making it easier for in-house recycling is a popular way of being more environmentally friendly. Packaging also contributes to reducing the amount of damage to freight (Thiell *et al.,* 2011).

### 3.2.2 Discussion of organisational, technical and internal practices

Following research conducted by CLECAT (European Association for Forwarding, Transport, Logistic and Customs services), a logistics best practise guide was published in 2010. This guide can be used by companies as a tool to implement the best possible green practise for their specific business needs and organisational structure. Many of the practices listed below were implemented and tested by various international logistics firms and feedback was given on each specific practise. The aim, method, costs and results of the best practices were presented in the best practise guide (CLECAT, 2010), aiming to assist companies to make the right decisions when implementing green logistics practices.

Tables 3.2 and 3.3 provide a summary of the best green practices that can be implemented at organisational, technical and internal level as stated in the logistics best practise guide (CLECAT, 2010) as presented in Figure 3.3 below.

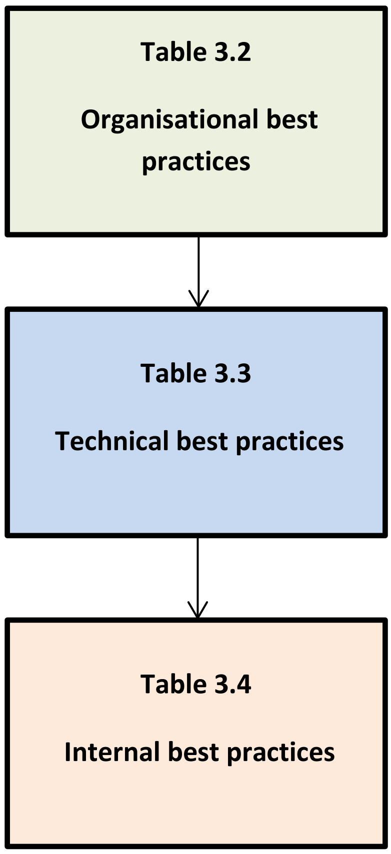


**Figure 3.3: Layout of discussion of Table 3.2–3.4**

Table 3.2 below consists of the organisational best practices of green logistics.

**Table 3.2: Organisational best practices**

| |
|---|
| Communication |
| Developing relationships |
| Development of a strategic environmental plan |
| Distribution consolidation |
| Double stacking |
| Fuel management for transport operators training of drivers, new technology |
| Implementation of an environmental management system (EMS) |
| Integrated management systems (IMS) |
| Multi-modal services: road to rail then to road again |
| Night-time deliveries |
| Optimal routing planning |
| Optimising load fill |
| Organisational practices |
| Reducing packaging |
| Transport collaboration |

**Source: Adapted from CLECAT (2010), Colicchia, Marchet, Melacini and Perotti (2013), Gonzalez-Benito and Gonzalez-Benito (2006) and Murphy and Poist (2000)**

Table 3.3 below reflects the technical best practices of green logistics.

**Table 3.3: Technical best practices**

| |
|---|
| Electric forklift trucks instead of diesel |
| Euro IV lubricating oils |
| Exchanging diesel vehicles with electric vehicles |
| Installing fleet management systems |
| Installing new washing facilities (modern washing facilities) |
| Installing software to reduce, measure, and monitor fuel consumption |
| Installing routing software |
| Load optimisation |
| Load planning software |
| Monitoring fuel consumption |
| Satellite tracking |
| Solar roof to save energy |
| Telematics |
| Development of double-deck trailers to replace single-deck trailers |
| Use of intermodal transport |
| Use of rainwater for vehicle cleaning |

**Source: Adapted from CLECAT (2010), Colicchia, Marchet *et al.* (2013), Gonzalez-Benito and Gonzalez-Benito (2006) and Murphy and Poist (2000)**

Table 3.4 below consist of the internal best practices of green logistics.

**Table 3.4: Internal best practices**

| |
|---|
| Bonus system to encourage drivers to drive safely and fuel efficiently |
| Creating safety manuals |
| Fuel-saving tips for drivers |
| Implementation of a guidance and communication system |
| Internal practices |
| Monitoring fuel consumption by installing fuel monitoring equipment |
| Personnel training |
| Promote environmental awareness among senior personnel |
| Promote internal training programmes |
| Reduce carbon footprint |
| Reduce engine idling |

**Source: Adapted from CLECAT (2010), Colicchia, Marchet *et al.* (2013), Gonzalez-Benito and Gonzalez-Benito (2006) and Murphy and Poist (2000)**

In order to achieve the fourth secondary objective of the study, namely to explore green logistics practices of logistics and transport companies located in Gauteng, these practices were required in section C of the survey (Appendix B) and tested amongst 160 logistics and transport companies in Gauteng. For the results of the best green logistics practices, refer to section 5.3.1.

Section 3.3 reports in more detail on what drives companies to implement these practices, what prevents companies from implementing the practices, and what the benefits of implementation are.

## 3.3 DRIVERS, BARRIERS AND BENEFITS FOR THE GREENING OF LOGISTICS AND SUPPLY CHAINS

Section 3.3 addresses the first three secondary objectives of the study, namely to –

- identify the main drivers behind implementing green logistics practices;
- explore the benefits of implementing green logistics practices; and
- determine the barriers preventing companies from implementing green logistics practices.

Various drivers of green logistics practices are continuously influencing the way companies observe environmental issues; companies therefore believe it is no longer optional to adopt environmental friendly behaviour but compulsory (Andiç, Yurt & Baltacıoğlu, 2012). There are many reasons for logistics and supply chain enterprises to implement these green practices. The phrase **green driver** refers to the initiatives and advantages linked with the incentives for ecological awareness (Andiç *et al.*, 2012). Various surveys have been conducted to investigate the motivation of transport enterprises to implement these green logistics practices. These surveys were conducted by:

– **eyefortransport (eft) (2007)**: "Key drivers for investigating green transport/logistics"

Eyefortransport is an American-based company that conducted a green transportation and logistics survey in 2007. A sample of 271 transportation and logistics professionals participated in the survey. This survey aimed to understand the reasons why companies engage in green activities.

The companies identified the following as the five most important drivers:

- improving public relations (70%);
- improving customer relations (70%);
- part of their corporate responsibility (60%);
- financial return on investment (60%); and
- government compliance (60%).

The following two were noted as the least important drivers:

- decreasing risk (50%); and
- improving investor relations (38%).

– **Aberdeen Group (2008):** "Top five pressures driving the green supply chain"

The Aberdeen Group is also an American-based company. They conducted a survey in 2008, which included over 330 companies from various industries.

The respondents of the survey identified the following as the five most important drivers:

- desire to be a thought leader in sustainability (51%);
- rising cost of energy/fuel (49%);
- gaining competitive advantage (48%);
- compliance with current/expected regulation (31%); and
- rising cost of transportation (24%).

The following two were noted as the least important drivers:

- compliance with expected regulations; and
- rising cost of transportation.

– **Bearing Point (2008)**: "Main drivers for green logistics"

Bearing Point conducted a survey in 2008, which included 600 professionals from companies located in Europe (mainly France and the United Kingdom), North America and Japan. The survey indicated that there is a relationship between companies with high turnovers and an interest in green supply chains – the bigger the company, the higher the level of awareness in a green supply chain. The survey revealed that, at that stage, 38% of companies in Europe had a green supply chain strategy in place. Of the companies in the UK, 45% and 30 % of those in France had green strategies in place, while only 24% of companies in the United States were implementing green activities. An interesting finding was that Japan had a 100% score rate in terms of companies which were implementing a green approach at that time, regardless of the size of the companies.

The companies identified the following as the five most important drivers:

- optimise logistics flow (18%);
- improve corporate image (16%);
- reduce logistics costs (15%);
- achieve regulatory compliance (15%); and
- satisfy customer requirements (14%).

The following two were noted as the least important drivers:

- differentiation from competitors (11%); and
- development of alternative networks (10%).

From the results above it seems that the participating companies were driven by –

- improving relations with the public and customers;
- improving their corporate image;
- desire to be a thought leader in sustainability;
- reducing logistics costs; and
- complying with government regulations.

The key drivers for the greening of logistics and supply chains are presented in Table 3.5 below.

**Table 3.5: Key drivers for the greening of logistics and supply chain management**

| Driver | Source | Method |
|---|---|---|
| Achieve legislative and regulatory compliance | Aberdeen Group, 2008<br>Min & Galle, 2011<br>Hall, 2001 | Survey Survey/questionnaire<br>Case study/interviews |
| Comply with regulations | Bearing Point, 2008<br>Zhu & Sarkis, 2006 | Survey<br>Survey/questionnaire |
| Collaborating with customers | Klassen & Vachon, 2003 | Survey/questionnaire |
| Decreasing fuel bills | eyefortransport, 2007 | Survey |
| Decreasing risk | eyefortransport, 2007 | Survey |

| Driver | Source | Method |
|---|---|---|
| Desire to be a thought leader in sustainability | Aberdeen group, 2008 | Survey |
| Developing alternative networks | Bearing Point, 2008 | Survey |
| Differentiating from competitors | Bearing Point, 2008 | Survey |
| Financial return on investment | eyefortransport, 2007 | Survey |
| E-logistics and environment | Sarkis, 2003 | Case study/interviews |
| Gaining competitive advantage | Aberdeen Group, 2008 | Survey |
| Government compliance | eyefortransport, 2007 | Survey |
| Improve corporate image | Bearing Point, 2008 | Survey |
| Improving customer and investor relations | eyefortransport, 2007 | Survey |
| Improving firm performance | Gonzάlez-Benito, 2005<br>Chen, 2005<br>Rao & Holt, 2005 | Industry analysis<br>Literature review<br>Survey/questionnaire |
| Improving public relations | eyefortransport, 2007 | Survey |
| Improving quality | Pil & Rothenberg, 2003 | Survey/questionnaire |
| Increasing supply chain efficiency | eyefortransport, 2007 | Survey |
| Investor pressure | Trowbridge, 2001 | Case study |
| ISO14000 certification | Montabon, Meinyk, Stroofe & Calantone, 2000 | Survey/questionnaire |
| Marketing pressures | Zhu & Sarkis, 2006 | Survey/questionnaire |
| Optimise logistics flow | Bearing Point, 2008 | Survey |
| Part of corporate social responsibility | eyefortransport, 2007<br>Bansal & Roth, 2000 | Survey |
| Pressure by environmental advocacy groups | Hall, 2001 | Case study/interviews |

| Driver | Source | Method |
|---|---|---|
| Pro-active action before regulation | Carter & Dresner, 2001 | Case study/interviews |
| Reduce logistics costs, desire to reduce costs | Bearing Point, 2008<br>Carter & Dresner, 2001 | Survey<br>Case study/interviews |
| Rising cost of fuel | Aberdeen Group, 2008 | Survey |
| Rising cost of transportation | Aberdeen Group, 2008 | Survey |
| Satisfying customer requirements | Bearing Point 2008 | Survey |
| Supplying integration | Vachon & Klassen, 2006 | Survey/questionnaire |

**Source: Aberdeen Group (2008), eyeforTransport (2007), Bearing Point (2008), McKinnon *et al.* (2010), Walker, Di Sisto & McBain (2008)**

In literature, various studies revealed that corporate image, competitive differentiation, cost savings, compliance to government regulation, collaboration with suppliers and improving firm performance are the key elements for the implementation of green logistics practices (Carter & Dresner, 2001; Gonzάlez-Benito, 2005; Klassen & Vachon, 2003; McKinnon *et al.*, 2010:17; Zhu & Sarkis, 2006). Research by Andiç *et al.* (2012) into green supply chain efforts and potential applications for the Turkish market identified two drivers as the most efficient: legislation and economic concerns. In addition, numerous surveys (Aberdeen Group, 2008) (Bearing Point, 2008) (eyeforTransport, 2007) show that companies globally are eager to endorse their green credentials through logistics management.

Although the protection of the environment was not a key driver; the Aberdeen Group (2008) and Bearing Point (2008) found that many companies taking part in their research indicated there were various benefits (Table 3.6) from implementing green practices.

**Table 3.6: Benefits for the greening of logistics and supply chain management**

| | |
|---|---|
| **Aberdeen Group (2008) (Best-in-class goals for sustainability initiatives)** | |
| Reduce overall business costs | 56% |
| Enhance corporate social responsibility | 54% |
| Improve profits | 48% |
| Reduce waste/improve disposal | 43% |
| Improve visibility of green supply drivers | 41% |
| Increase use of recyclables | 37% |
| Improve fuel efficiency | 35% |
| Reduce emissions | 33% |
| Develop new products/Win new customers | 26% |
| Reduce use of toxic materials | 19% |
| Improve employee satisfaction | 9% |
| **Bearing Point (2008) (Benefits of the green supply chain)** | |
| Improve brand image | 70% |
| Satisfy customer requirements | 62% |
| Differentiate from competitors | 57% |
| Reduce logistics costs | 57% |
| Establish a competitive advantage | 47% |
| Optimise logistics flow | 40% |
| Expand to new markets | 38% |
| Optimise manufacturing | 35% |
| Reduce manufacturing costs | 32% |
| Other | 2% |

**Source: Aberdeen Group (2008), Bearing Point (2008), McKinnon *et al.* (2010)**

From Table 3.6 it is evident that there are many benefits for logistics and transportation organisations to implement green practices. In order to gain any benefits there are certain hurdles or barriers that these organisations have to overcome in order to implement these practices.

Table 3.7 reflects the barriers for the implementation of green supply chain practices identified in literature.

**Table 3.7: Barriers for the implementation of green supply chain practices**

| Barrier | Description of barrier | Resource |
|---|---|---|
| Cost of implementation for GSCM | Indicates the high amount of capital required to implement green practices such as green packaging, manufacturing, labelling, etc. | Balasubramanian, 2012<br>Liu *et al.,* 2012 |
| Customers' unawareness towards GSCM products and services | Customers are uninformed of green products and their advantages | Sharma, 2012<br>Balasubramanian, 2012 |
| Lack of acceptance of advancement in new technology | Emphasises the importance of accepting the evolution of technology, and adapting to change by replacing the old systems used in an established organisation | Balasubramanian, 2012<br>Holt, 2009 |
| Lack of energy management and waste management of the organisation | Poor organisational management regarding resources | Singh, 2008 |
| Lack of external sustainability audits for suppliers and contractors | The integration of supply chain-related external departmental issues | Walker & Preuss, 2008 |
| Lack of government initiatives system for GSCM practitioners | Government must make a conscious decision to implement green policies and give benefits to those already implementing green practices | Balasubramanian, 2012<br>Liu *et al.,* 2012 |
| Lack of green architects, consultants, green developers, contractors in the region | Lack of green experts | Holt, 2009 |
| Lack of integration of IT systems | Consists of information exchange processes using software and computer based applications | Balasubramanian, 2012 |
| | | |

| Barrier | Description of barrier | Resource |
|---|---|---|
| Lack of internal sustainability audits within the organisation | The integration of supply chain-related internal departmental issues | Walker & Preuss, 2008 |
| Lack of knowledge and experience | Among supply chain stakeholders | Holt, 2009 |
| Lack of management initiatives for transport and logistics | Shows inadequate logistics management in the organisation | Singh, 2008 |
| Lack of professional treatment and long-term contracts for adopting GSCM from government | Little support given by government to organisations implementing GSCM practices | Sharma, 2012<br><br>Balasubramanian, 2012 |
| Lack of skilled human resource professionals in sustainability and GSCM | Suggests the lack of the human resources departments' abilities to provide training in GSCM | Balasubramanian 2012 |
| Lack of sustainability certification like ISO 14001 | Quality of products and services | Sharma, 2012<br><br>Balasubramanian, 2012 |
| Lack of top-level management commitment | Top-level management refrains from implementing green practices | Min & Galle, 2001; Balasubramanian 2012; Liu *et al.,* 2012 |
| Lack of training in GSCM | Lack of training that employees of an organisation receive, therefore hampering the implementation of green practices in the supply chain | Sharma, 2012<br><br>Carter & Dresner, 2001 |
| Poor implementation of green practices within a supply chain | Lack of concern for environmental practices within the supply chain, for example reusing and recycling and waste disposal | Holt, 2009<br><br>Yu Lin & Hui Ho, 2008 |
| Poor organisational culture in GSCM | Top-level management plays a critical role in encouraging employees | Yu Lin & Hui Ho, 2008<br><br>Chien & Shih, 2007 |
| Supplier's flexibility to change towards GSCM | Reflects the supplier's resistance to be part of the design process and technology | Sharma, 2012<br><br>Balasubramanian, 2012 |

| Barrier | Description of barrier | Resource |
|---|---|---|
| Uncertainty and competition in market | This can be a result of global competitiveness and unpredictable customers' requirements | Mudgal, Shankar, Talib & Raj, 2010 |

**Source: Adapted from Carter and Dresner (2001), Dashore and Sohani (2013: 2025), Min and Galle (2001)**

Twenty universal barriers towards the implementation of green logistics or supply chain were identified and listed in Table 3.7. Management must pay close attention to these barriers as they can prevent companies from implementing green initiatives successfully.

In order to achieve the first three secondary objectives of the study, namely to

- *identify the main drivers behind implementing green logistics practices;*
- *explore the benefits of implementing green logistics practices; and*
- *determine the barriers preventing companies from implementing green logistics practices,*

these drivers, barriers and benefits identified in literature, were required in section B of the survey (Appendix B) and tested among 160 logistics and transport companies in Gauteng.

For the results on the section dealing with the drivers, barriers and benefits of green logistics practices see Chapter 5 section 5.2.2.

In section 3.4, the green logistics barriers and drivers specifically applicable to South Africa are discussed.

## 3.4 GREEN LOGISTICS BARRIERS AND DRIVERS SPECIFICALLY APPLICABLE TO SOUTH AFRICA

In their research in South Africa, Göransson and Gustafsson (2014) conducted interviews with the managers of transportation companies located in Johannesburg, Gauteng. The respective companies were DB Schenker, UPS, Barloworld Logistics, Imperial Logistics, DHL Global forwarding, Unitrans, DSV and one logistics expert in the field, Ittmann. Both barriers and drivers (incentives) were identified and are discussed below.

### 3.4.1 Incentives (drivers) for green logistics in South Africa

Various incentives for green logistics were identified by these managers from; DB Schenker, UPS, Barloworld Logistics, Imperial Logistics, DHL Global forwarding, Unitrans and DSV. From a managerial perspective, incentives would have to be a financial or monetary incentive and should be based on performance, because there are currently no government incentives in place in terms of trucking. More companies should be encouraged to implement green logistics by using rebates. One of the main incentives identified is cost savings. Being green can be seen as a competitive advantage, and it can be used as a marketing tool amongst consumers. Ms Mothibi from Imperial Logistics indicated that from a marketing perspective, clients are more likely to give contracts to companies who have green logistics and sustainability projects in place. Another major incentive for companies to implement green practices is carbon tax that will be implemented from 2016 (Cohen, 2014). Other incentives such as driver incentive plans, corporate image and branding were also mentioned by the various managers.

### 3.4.2 Barriers for green logistics in South Africa

Some of the barriers identified by the various managers are listed below:

- Education regarding green logistics needs to be improved among employees and a culture of environmental awareness needs to be enforced from management;
- The condition and poor quality of roads in rural areas is problematic;
- SA's infrastructure is a major problem;
- Limited modes of transport are available to use in South Africa; our rail system is inefficient and unreliable;

- Since cleaner fuel is not available in South Africa, it is not possible to import the top of the range Euro trucks namely the Euro 4 or Euro 5 trucks;
- Currently Euro 2 trucks are the legislative vehicles in South Africa;
- The high cost of the latest Euro vehicle technology makes it impossible for most logistics companies to purchase the technology;
- Unavailability of technology – most of the advanced Euro technology is not available in our country;
- Client awareness – customers are not prepared to pay for greener products or green operations; and
- E-tolls, fuel prices and high logistics costs were important barriers identified by the managers of the respective firms.

Based on the above barriers, Göransson and Gustafsson (2014) concluded that, at the time of their research, infrastructure and technology were the main barriers preventing companies in South Africa from implement green logistics practices.

## 3.5 CONCLUSION

Chapter 3 addressed the first four secondary objectives of the study:

- to identify the main drivers behind implementing green logistics practices;
- to explore the benefits of implementing green logistics practices;
- to determine the barriers preventing companies from implementing green logistics practices; and
- to explore green logistics practices of logistics and transport companies located in Gauteng.

The first three secondary objectives were discussed in section 3.3. The main drivers, benefits and barriers were identified in literature and required in section B of the survey (Appendix B) from 160 logistics and transport companies in Gauteng. For the results of the drivers, barriers and benefits of green logistics practices, see 5.2.2.

The fourth secondary objective of the study was discussed in section 3.2. The global best green logistics practices can be implemented on six hierarchical levels of a company. Section

3.2.1 discussed the first three levels, namely the strategic, tactical and operational level. Section 3.2.2 discussed the remaining three levels, namely the organisational, technical and internal level. These practices were required in section C of the survey (Appendix B) from 160 logistics and transport companies in Gauteng. For the results of the best green logistics practices, see 5.3.1.

In the next chapter, the research methodology of the study is discussed.

# CHAPTER 4

## RESEARCH DESIGN AND METHODOLOGY

### 4.1 INTRODUCTION

In Chapter 4, the research design, research objectives, problem statement, research methodology, research instrument, limitations and ethical considerations of the study are discussed. The main purpose of the research on which this study is based was to draw valuable conclusions of the green logistics data analysed, and thus contribute to SMEs and large logistics companies with a framework in green logistics. The chapter will follow the flow diagram depicted in Figure 4.1.


**Figure 4.1: Flow diagram of Chapter 4**

## 4.2 DEFINING THE RESEARCH DESIGN

A research design is defined by Van Zyl (2014:397) as "the method and structure of an investigation chosen by the researcher to conduct data collection and analysis". Blumberg, Cooper and Schindler (2008:195) identified the following definition of a research design.

> *Research design is the plan and structure of investigation so conceived as to obtain answers to research questions. The plan is the overall scheme or program of the research. It includes an outline of what the investigator will do from writing hypotheses and their operational implications to the final analysis of data. A structure is the framework, organization, or configuration of … the relations among variables of a study. A research design expresses both the structure of the research problem and the plan of investigation used to obtain empirical evidence on relations of the problem*.

Although there are various definitions of a research design, Blumberg *et al.* (2008) identified the fundamentals of a research design:

- the design is an activity- and time-based map;
- the design is usually based on the research questions formulated;
- the design directs the selection of sources and different types of information;
- the design is a framework for identifying the relationships among the study's variables; and
- the design stipulates methods/techniques for every research activity.

## 4.3 THE CLASSIFICATION OF RESEARCH DESIGNS

Saunders, Lewis and Thornhill (2012) identify three types of research designs, namely exploratory, descriptive and explanatory. These designs are discussed briefly below.

**Exploratory research –** a constructive way of gaining an in-depth understanding of a particular subject. Exploratory research is especially useful if the researcher is unsure about the nature of the problem and wishes to investigate it further. The advantage of exploratory research is that it is open to change. Various methods can be used to conduct exploratory research, namely interviews with experts in the field, one-on-one interviews and focus group discussions (Saunders *et al.*, 2012).

**Descriptive research** – Zikmund *et al.* (2010:55) define descriptive research as research that defines characteristics of objects, people, groups, organisations, or environments; descriptive research tries to paint a picture of a given situation.

**Explanatory research –** Saunders *et al.* (2012) describe explanatory research as studies that confirm causal relationships between variables. The main aim of explanatory research is investigating a particular problem in order to describe the relationships between the variables.

The main research approach followed in the research on which this study is based, contained elements of both exploratory and descriptive research designs. The concept of green logistics was explored through various secondary sources such as accredited journals, the internet, newspapers and magazines to gain an in-depth understanding of the topic of green logistics and the current situation of green logistics in South Africa. In order to establish to which extent South African companies are implementing green logistics practices, data analysis was conducted using descriptive and inferential statistics which describe the green practices being implemented. Therefore, the study included both exploratory and descriptive research design elements.

## 4.4 RESEARCH OBJECTIVES OF THE STUDY

### Primary objective

The primary objective of this study was to develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice.

### Secondary objectives

The following secondary objectives were set to achieve the primary objective:

- to identify the main drivers behind implementing green logistics practices;
- to explore the benefits of implementing green logistics practices;
- to determine the barriers preventing companies from implementing green logistics practices;
- to explore green logistics practices of logistics and transport companies located in Gauteng;
- to compare green logistics practices of SMEs and larger companies in Gauteng; and
- to provide large companies and SMEs with guidelines on how to implement green logistics practices.

## 4.5 PROBLEM STATEMENT OF THE STUDY

As discussed in Chapter 1, the problem statement can be phrased as*: What are the green logistics practices that logistics and transport companies in the industry are currently implementing in terms of key drivers, benefits and barriers, and how can these companies benefit from green practices while achieving future goals and promoting sustainability in South Africa?*

## 4.6 DEFINING THE RESEARCH METHODOLOGY

Blumberg *et al.* (2008:56), De Vos, Strydom, Fouché and Delport (2011) and Mouton (2001) define the research process as well-defined steps that follow in a chronological order. These steps are summarised in Figure 4.2 below.

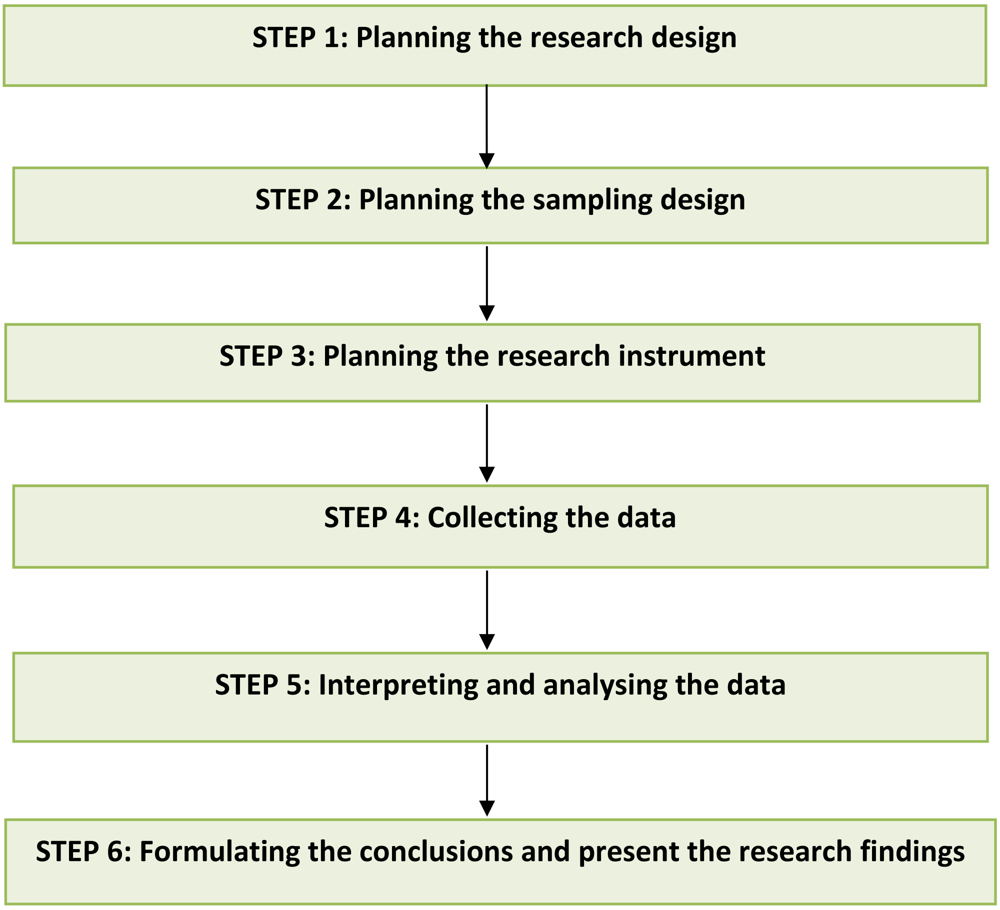


**Figure 4.2: The research process**

**Source: Adapted from Blumberg *et al.* (2008), De Vos *et al.* (2011), Mouton (2001)**

### 4.6.1 STEP 1: Planning the research design

Creswell (2009) identified three types of research approaches, namely quantitative, qualitative and the mixed methods approach. For the purpose of this study, a quantitative research approach was chosen, and an online survey was used as the main research instrument. The research instrument was selected based on a similar study conducted by Smith and Perks (2010) in the Nelson Mandela Metropole on the perceptions of businesses regarding the effect of green practice implementation on the business functions. In the current research study, a self-administered questionnaire also served as the primary research instrument, but it was converted into a Lime survey to be emailed to the respondents through a survey link. A Lime survey is user-friendly and data is accurate, it stores easily and can be converted into the statistical package SSPS v22. Surveys are mostly used for exploratory and descriptive research designs (Saunders *et al.*, 2012).

There are two main types of quantitative research designs, namely experimental designs and non-experimental designs (De Vos *et al.*, 2011). The type chosen for the current study was non-experimental designs, where surveys (questionnaires) is the most popular method and it is especially used in descriptive studies (De Vos *et al.*, 2011). Descriptive research designs are mostly structured and particularly designed to evaluate the characteristics described in the research questions (Hair, Celsi, Money, Samouel & Page, 2011).

Table 4.1 by Creswell (2009:17) reflects the three main research approaches, namely a qualitative approach, quantitative approach and a mixed methods research approach. The primary research instrument employed by the current study was a Lime survey which contained close-ended questions and numeric data. The methods for data analysis used were descriptive and inferential statistics; therefore, a quantitative research approach was followed.

**Table 4.1: Qualitative, quantitative and mixed methods approaches**

| Tend to or typically … | Qualitative approach | Quantitative approach | Mixed methods approach |
|---|---|---|---|
| **Use these philosophical assumptions** | Constructivist/ advocacy/participatory knowledge claims | Post-positive knowledge claims | Pragmatic knowledge claims |
| **Employ these strategies of inquiry** | Phenomenology, grounded theory, ethnography, case study and narrative | Surveys and experiments | Sequential, concurrent and transformative |
| **Employ these methods** | Open-ended questions, emerging approaches, text or image data | Close-ended questions, predetermined approaches, numeric data | Both open - and close-ended questions, both emerging and predetermined approaches and both quantitative and qualitative data analysis |

| Tend to or typically … | Qualitative approach | Quantitative approach | Mixed methods approach |
|---|---|---|---|
| **Use these practices of research as the researcher …** | • Positions him - or herself<br>• Collects participant meanings<br>• Focuses on single concept or phenomenon<br>• Brings personal values into the study<br>• Studies the context or setting of participants<br>• Validates the accuracy of findings<br>• Makes interpretations of the data<br>• Creates an agenda for change or reform<br>• Collaborates with participants | • Test or verifies theories or explanations<br>• Identifies variables to study<br>• Relates variables in questions or hypotheses<br>• Uses standards of validity and reliability<br>• Observes and measures information numerically<br>• Uses unbiased approaches<br>• Employs statistical procedures | • Collects both quantitative and qualitative data<br>• Develops a rationale for mixing<br>• Integrates the data at different stages of inquiry<br>• Presents visual pictures of the procedure in the study<br>• Employs the practices of both quantitative and qualitative research |

**Source: Creswell (2009:17)**

### 4.6.2 STEP 2: Planning the sampling design

Zikmund *et al.* (2010:391) presents the following stages to select a sample successfully.

**4.6.2.1 Define the target population**

**4.6.2.2 Select a sampling frame**

**4.6.2.3 Determine if a probability or non-probability sample will be chosen**

**4.6.2.4 Plan the procedure for selecting sample units**

**4.6.2.5 Determine sample size**

**Figure: 4.3: Stages in the selection of a sample Source: Zikmund *et al.* (2010:391)**

#### *4.6.2.1 Defining the target population*

Cooper and Schindler (2011) define the target population as people, events or records that encompass the necessary information, and are able to answer the measurement questions. In the current research, the target population was the managers of logistics and transport companies that were located in Gauteng.

#### *4.6.2.2 Select a sampling frame*

A sampling frame is defined by Zikmund *et al.* (2010:391) as a list of the population elements that the sample will be drawn from, also known as the working population. The Braby's database was used to compile a list of all the logistics and transport companies operating in Gauteng (refer to Appendix D). Braby's is an online map and business search directory for South Africa. The participating companies' contact details and locations were freely available on Braby's and the internet, as most companies advertising their services on Braby's have their own corporate websites available on the internet.

Braby's database consists of logistics services that are divided into seven categories namely:

Category 1: Logistics (45 companies identified)
Category 2: Logistics management (4 companies)
Category 3: Logistics software solutions (1 company)
Category 4: Logistics services (140 companies)
Category 5: Logistics and transportation (2 companies)
Category 6: Logistics and distributers (4 companies)
Category 7: Procurement and logistics (2 companies)

At the time of the research, a total of 198 companies was listed under logistics services. At the time of the research, no specific logistics and transport database existed in South Africa; therefore, Braby's was selected as it was the online database with the most logistics and transport companies listed. Although many companies were listed on Braby's, some of these companies had relocated over the years, some had been liquidated or their contact details were no longer applicable. After careful research, visiting the company's websites and phoning the office numbers, 139 companies were identified with operational email addresses.

After consultation with an expert in the logistics field, 21 companies who were not on Braby's list were added on account of being major competitors in the logistics industry and because they could provide valuable inputs regarding their green activities. Therefore, a total of 160 logistics and transport companies were identified and included in the sampling frame. The Lime survey was sent to the managers of the various companies. A census was conducted and information was obtained from each member of the population group. See Appendix D for the database of the 160 companies contacted.

Figure 4.4 indicates the major areas where these companies operate in Gauteng.


**Figure: 4.4: Map of Gauteng**

**Source: SA Places (2015)**

#### 4.6.2.3 *Determine whether a probability or non-probability sample would be chosen*

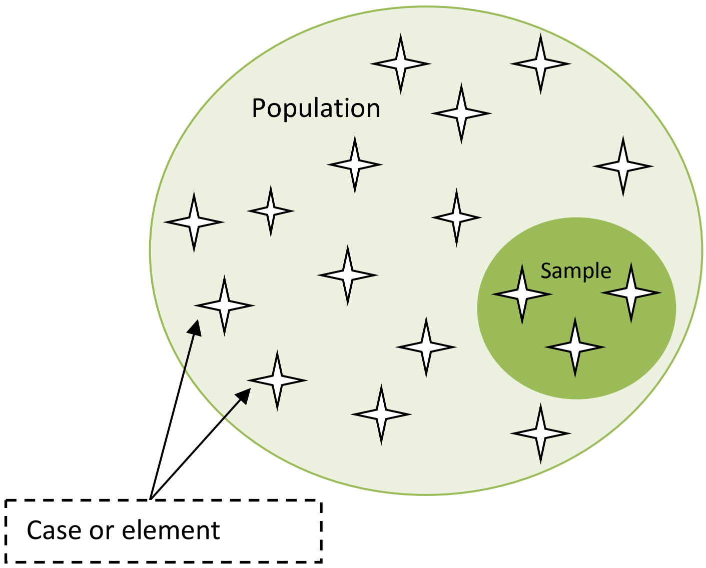


**Figure 4.5: Population, sample, and individual cases**

**Source: Saunders *et al.* (2012:259)**

As illustrated in Figure 4.5 a researcher is often faced with the decision whether or not sampling is necessary for the research study. There are various types of sampling methods one could use. Probability sampling is a sampling method in which every member of the population has a known, nonzero probability of selection and consists of; simple random, systematic, stratified, cluster and multi-stage sampling (Zikmund *et al.*, 2011).

Non-probability sampling is a technique in which units of the sample are chosen on the basis of personal judgment or convenience. The probability of any particular member being chosen is unknown and consists of; convenience, purposive, judgment, quota and snowball sampling (Zikmund *et al.*, 2011).

After careful examination of the research objectives and the purpose of the current study, sampling was not used, and data was collected from each and every member of the target population as identified through the sampling frame. This is known as a census (Cooper and Schindler, 2011).

According to Cooper and Schindler (2011), two conditions are suitable for a census study:

- when the population is small; and

- when the elements are different from each other, or the variety of their service offerings makes it hard to sample from this group.

A census was the most appropriate data collection method chosen, because the population group was small, and only entailed 160 logistics and transport companies. These companies specialised in different fields within logistics such as warehousing, retailing, supplying or distributing. A census allowed the researcher to gain an in-depth understanding of the green logistics situation in South Africa, and of the extent to which small and large companies were implementing green practices at the time of the research. A response rate of 22.5% was achieved, where 36 out of 160 companies responded. Malhotra and Grover (1998) indicate that a response rate of 20% is sufficient for a constructive assessment of the survey. This is also confirmed by du Plessis (personal communication, 2014) an expert in the field of logistics that research studies of this nature are often confronted with low response rates.

#### *4.6.2.4 Plan the procedure for selecting sample units*

A sample unit is a single element or group of elements subject to selection in the sample (Zikmund *et al.*, 2010). In the current study, the sample units refer to the group of elements that were selected. The group of elements comprised the 160 logistics and transport enterprises identified. These companies were identified and approached by the researcher in order to participate in the Lime survey. The list of companies (see Appendix D) adhered to the following criteria:

- the companies' head offices, holding companies, branches, subsidiaries or independent units were located in Gauteng;
- the companies engaged in logistics or transportation activities and operated in Gauteng; and
- the companies' email addresses, contact details and locations were freely available on the internet and their corporate websites.

#### *4.6.2.5 Determine the sample size*

For the purpose of this study, no sample size determination applied, as a census was conducted.

### 4.6.3 STEP 3: Planning the research instrument

There are various types of data collection methods to choose from when a quantitative approach is followed. These quantitative data collection methods can be divided into the categories as displayed in Figure 4.6, namely structured interview schedules, structured observation schedules, surveys (questionnaires), indexes and scales. For the current study, the quantitative data-collection instrument chosen was a survey, more specifically a Lime survey.

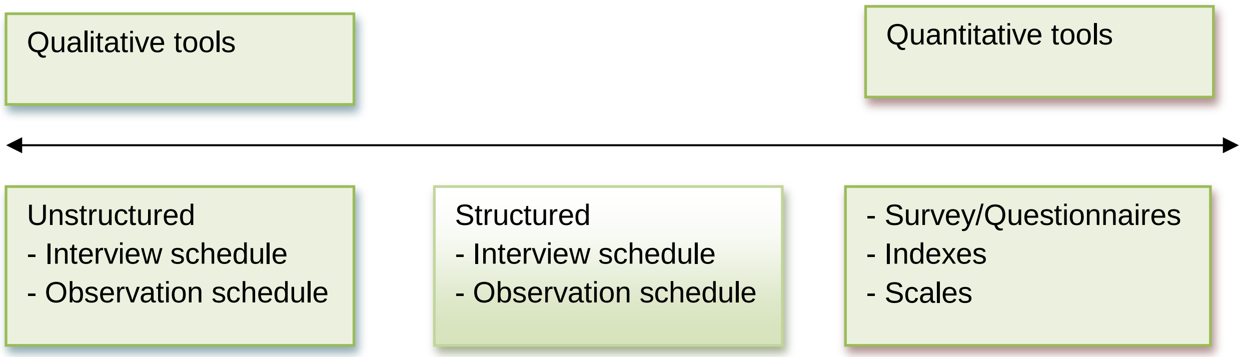


**Figure 4.6: Continuum of data collection instruments**

**Source: De Vos *et al.* (2011:181)**

In order to collect primary data from organisations, a Lime survey, which consisted of a self-completion questionnaire, was emailed to the participants on 9 September 2014. The Lime survey consisted of a survey link, which was emailed to the participants for self-completion.

> *Self-completion approaches to collecting data use structured questionnaires. A structured questionnaire is a predetermined set of questions designed to capture data from respondents. It is a scientifically developed instrument for measurement of key characteristics of individuals, companies, events, and other phenomena* (Hair *et al.*, 2011:198).

As displayed in Figure 4.7, self-administered surveys can be divided into two categories: paper surveys and electronic surveys. The most suitable type chosen for this study was electronic surveys (Zikmund *et al.*, 2010), more specifically a Lime survey. The transport and logistics companies were located in different parts of Gauteng and could easily be reached through email (refer to the map of Gauteng depicted in Figure 4.4). The Lime survey is user-friendly and can easily be completed by participants.

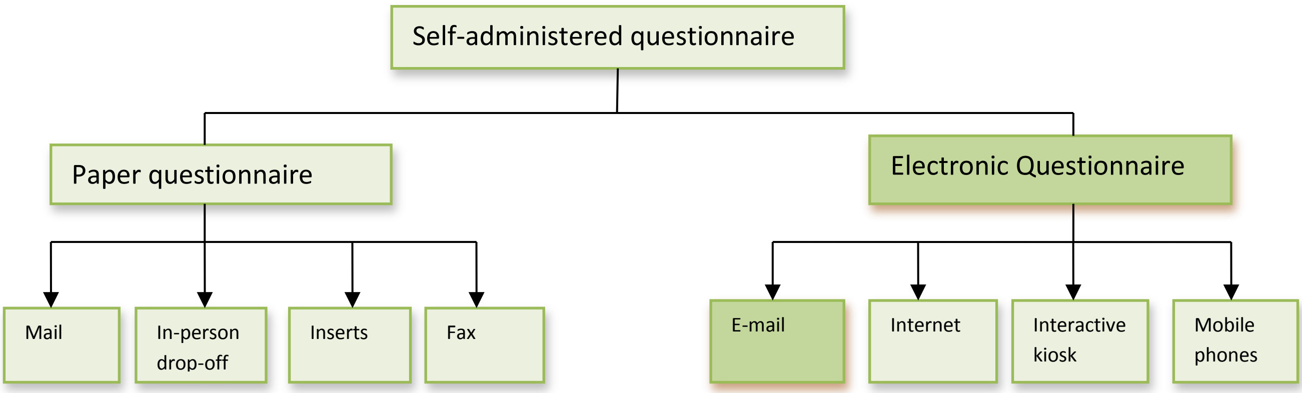


**Figure 4.7: Self-administered survey/questionnaire types**

**Source: Adapted from Zikmund *et al.* (2010: 219)**

#### *4.6.3.1 Advantages and disadvantages of a self-administered electronic survey*

Zikmund *et al.* (2010:219) identified the following advantages and disadvantages of an email survey.

Geographic flexibility and access to larger population groups are some of the main advantages of a Lime survey (Cohen, Manion & Morrison, 2007). Respondents in isolated areas can easily be reached, and trucking companies located in different parts of the country can be contacted at the same time. Lime surveys are inexpensive compared to other data collection methods (such as interviews and case studies) (Cohen *et al.*, 2007). Respondents can conveniently complete surveys in their own time, with the assurance that they will do so anonymously and that their answers will be kept confidential.

Although the questions are structured and standardised, the absence of an interviewer can create some difficulties, should the respondent wish to clarify a question. The length of a survey should be carefully considered to avoid participants losing interest. The main disadvantage of a Lime survey is the low response rate. Various techniques can be used to encourage participants to respond in a timely manner. These techniques include a cover letter stating the importance of completing and submitting the survey. Advanced notification must be given to companies so that they can expect the survey. Follow-up telephone calls are also effective to increase the response rates as well as interesting questions to keep the respondent interested to complete the survey.

Cohen *et al.* (2007) highlight the following issues regarding the reliability and validity of surveys. The authors state that, because surveys are anonymous, they tend to be reliable and some respondents feel at ease to give their honest opinion while filling out the surveys. In an interview, respondents will more likely give answers that they think the interviewer would like to hear in order not to disappoint him or her.

Cohen *et al.* (2007) also identified the following disadvantages:

- many respondents rush while filling in the survey because of their busy schedules;
- respondents could interpret questions in more than one way;
- low response rates;
- small or skewed samples may influence the data;
- answers may be incorrect due to limited literacy; and
- language barriers may influence the outcome of results.

#### *4.6.3.2 Survey design and layout*

Maree (2007) identified the following important aspects for designing and structuring a survey:

- *Instructions*: Clear and concise instructions should be given to the respondent, in order to obtain accurate results. Each section of the survey should have a clear explanation of what the section entails and how it should be answered.
- *Appearance of the survey*: The appearance of the questionnaire may encourage the respondent to complete it; therefore, it is important to ensure the survey is user-friendly. With regard to user-friendliness, a survey link was created in the current research, making it easier for respondents to participate.
- *Completion time of the survey:* The average time to complete the survey was 20 minutes.

- *Question sequence*: It is important that the respondent feel at ease while filling in the survey. This can be achieved by starting with general open-ended questions, then moving on towards topic-related questions, and arranging similar questions together.
- *Types of questions*: The survey consisted of two types of questions: open and close-ended questions.

The questionnaire titled "Green logistics questionnaire for selected companies in South Africa" (Appendix B), consisted of three sections A, B and C, as outlined in Table 4.2 below.

**Table 4.2: Layout of the design of the survey**

| Research objectives of the study | Section in the survey | Section in Chapter 3 | Type of question | Scale |
|---|---|---|---|---|
| 1. To identify the main drivers behind implementing green practices | **B** Drivers, benefits and barriers of green logistics practices | Table 3.5 | Close-ended | 5-point importance Likert scale |
| 2. To explore the benefits of implementing green logistics practices | **B** Drivers, benefits and barriers of green logistics practices | Table 3.6 | Close-ended | 5-point importance Likert scale |
| 3. To determine the barriers of implementing green logistics practices | **B** Drivers, benefits and barriers of green logistics practices | Table 3.7 | Close-ended | 5-point importance Likert scale |
| 4. To explore green logistics practices of logistics and transport companies located in Gauteng | **C** Best practices in green logistics management | Table 3.1<br>Table 3.2<br>Table 3.3<br>Table 3.4 | Close-ended | 5-point importance and difficulty Likert scale |
| 5. General information | **A** Participant information sheet and general information | | Close-ended | |

The fifth secondary objective of the study namely; *to compare green logistics practices of SMEs and larger logistics and transport companies,* and the sixth secondary objective of the study namely; *to provide larger companies and SMEs with guidelines on how to implement green logistics practices,* was achieved by interpreting the results of the data, and recommendations for small and large companies were made based on the findings of section A, B and C of the survey (see section 5.7.1.1 and section 5.7.2.2).

**Section A** of the questionnaire (Appendix B) consisted of closed-ended questions. The respondents were asked to provide general information such as the –

- corporate position of the respondent;
- annual turnover of the company;
- number of employees in the company;
- fleet (number of vehicles) in the company;
- warehouses in square meters;
- status of the company they worked for; and
- awareness of the concept of green logistics.

**Section B** of the survey consisted of the drivers, benefits and barriers of green logistics

- Drivers of green logistics
- Benefits of green logistics
- Barriers of green logistics

A five-point Likert-type scale[8] was used to determine the perceived importance of each driver, barrier and benefit of green logistics. The Likert-type scale used is displayed in Table 4.3.

[8] A Likert-type scale is based on the notion that each statement/item on the scale has equal 'attitudinal value', 'importance' or 'weight' with regard to reflecting an attitude towards the issue in question (Kumar, 2005).

**Table 4.3: Importance Likert scale used in Section B & C of questionnaire**

| **Section in the questionnaire** | **Applicable Likert scale used IMPORTANCE SCALE** | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| **B & C** | Not important at all | Of little importance | Somewhat important | Very important | Extremely important |

**Section C** of the questionnaire consisted of the best practices in green logistics management. The best practices were divided into the following categories:

- strategic best practices;
- tactical best practices;
- operational best practices;
- organisational best practices;
- technical best practices; and
- internal best practices.

A five-point Likert-type scale was used to determine the importance and difficulty of implementing each of the practices, and to determine whether South African companies are currently implementing international best practices or not. Table 4.4 displays the 5-point difficulty scale.

**Table 4.4: Difficulty Likert scale used in section C of the questionnaire**

| **Section in the questionnaire** | **Applicable Likert scale used DIFFICULTY SCALE** | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| **C** | Very easy to implement, few resources needed, little time or complexity | Easy to implement, some resources and time needed | Moderately difficult to implement, moderate complexity, can be remediated with moderate resources and time | Very difficult to implement, resources and time required and is most likely complex | Extremely difficult to implement, high impact of resources and time, very complex |

At the end of sections B and C, an additional block was inserted where the respondent could comment on any of the questions asked (See Appendix B for the questionnaire).

### 4.6.4 STEP 4: Collecting the data

A total of 160 logistics and transport companies were identified by the researcher with operational email addresses. This was achieved by contacting companies confirming that their email addresses are correct, and visiting their corporate websites on the internet to ensure the survey was sent to the correct manager. The researcher compiled a list of logistics and transport companies which operate in Gauteng and which engage in logistics and transport activities with functioning email addresses (See Appendix D for the database).

After the list had been compiled, a pilot survey was sent out on 2 September 2014 to two companies and three logistics experts in the field. “A pilot test is conducted to detect weaknesses in design and instrumentation and to provide proxy data for selection of a probability sample” (Cooper & Schindler, 2011:89). After the necessary changes had been made, the data collection process commenced and the Lime survey was sent out on 9 September 2014 to the 160 companies.

After two weeks, with low response rates, a reminder email was sent out. The reminder email encouraged a few of the participants to respond. Various telephone calls were made to the managers of the companies, encouraging the participants to respond. After a waiting period of six weeks, a response rate of 22.5% was achieved and the data collection process was finalised on 24 October 2014. Although 36 out of 160 companies responded, achieving a response rate of 22.5%, only 21 companies completed the entire questionnaire, and 15 companies completed the survey up to a certain point. The response rate deemed appropriate for the purpose of the study.

### 4.6.5 STEP 5: Interpreting and analysing the data

After the data collection procedure, the quantitative data was cleaned, analysed and interpreted. The Lime survey program exported the data electronically to Excel, and analysis and interpretation were conducted using SSPS v22 (Statistical Package for the Social Sciences).

The four broad categories that quantitative methods of analysis can be divided into are descriptive, associative, causative and inferential (De Vos *et al.*, 2011). The category used for this study was descriptive and inferential, because of the sample size and response rate.

**Table 4.5: Categories of data analysis techniques**

| Category | Aim | Method of analysis |
|---|---|---|
| 1. Descriptive | Describe the distribution of the sample<br>• Frequency<br>• Central tendency<br>• Dispersion | Univeriate – focusing on one variable |
| 2. Associative | Assess the association of the position of one variable with the likely position of another variable<br>• Correlation<br>• Analysis of variance<br>• Regression | Bivariate – comparing two variables |
| 3. Causative | Determine the network of relationships between variables<br>• Factor analysis<br>• Path analysis<br>• Regression | Multivariate – comparing more than two variables |
| 4. Inferential | Estimate population characteristics from sample characteristics and sample differences to population differences<br>• Different types of tests of significance | Multivariate |

**Source: de Vos *et al.* (2011:251)**

As displayed in Table 4.5, the aim of descriptive statistics is to describe the distribution of the sample through frequencies, central tendencies and dispersion (de Vos *et al.*, 2011). The aim of inferential statistics is to estimate population characteristics from sample characteristics. The type of inferential statistical test used in this study was a nonparametric Mann–Whitney U test (Zikmund *et al.*, 2010). Nonparametric statistics are suitable when the variable being analysed does not conform to any known or continuous distribution (Zikmund *et al.*, 2010). The Mann–Whitney U test can be used when two independent groups need to be compared based on a single variable. It is useful to apply this test when the sample from the population is small or if the data type is ordinal. The reason for using this test is that, when all the values of the study variable are ranked according to which group the values belong, the ranks should be evenly spread across the two groups if the two populations have equal medians.

The data interpretation was thus conducted using descriptive statistical analysis and inferential statistical analysis. Utilising descriptive analysis, an opportunity analysis was conducted and the results were further explored by using the four quadrant portfolio matrix principles. The main purpose of the study was not to conduct higher statistical analysis of the green logistics data, but to contribute through providing small and large logistics companies with a framework in green logistics, to assist them in sustaining the practise.

Data-analysis are in detail in Chapter 5.

### 4.6.6 STEP 6: Formulating the conclusions and present the research findings

After interpreting the data, the final step was to present the research findings. The research findings of the green logistics data are in Chapter 5 of the dissertation.

## 4.7 VALIDITY AND RELIABILITY OF THE STUDY

Quantitative research *validity* indicates that a researcher can draw significant and useful inferences from scores on specific instruments (Creswell, 2009).

Saunders *et al.* (2012:193) identified five forms of validity to guarantee the quality of research, namely internal validity, content validity, criterion-related validity, construct validity and external validity.

- *Internal validity* – is achieved when the research demonstrates a causal relationship between two variables. With regard to a questionnaire, internal validity refers to capability of the questionnaire to measure what you intend it to measure.

- *Content validity* – the degree to which the measurement questions in the questionnaire provide sufficient coverage of the investigative questions (Saunders *et al.*, 2012). Determining content validity implies justifying each question in relation to the objectives of the study. For the current study, content validity was established in that three academics and two experts in the logistics field examined the questionnaire, and their recommendations were implemented. Moreover, the questions were based on the literature and previous studies.

- *Criterion-related validity* – is concerned with the competence of the measures, which refers to the questions, to make precise or truthful predictions. It is also concerned with how accurate a test estimates present performance (concurrent validity) or alternatively how accurate it predicts future performance (predictive validity) (Van Zyl, 2014).

- *Construct validity* – refers to investigators or researchers using sufficient definitions and measures of variables (Creswell, 2011). Construct validity inspects whether test performance displays an underlying construct or set of linked variables (Van Zyl, 2014).

- *External validity* – refers to the question whether a study's research findings can be generalised or are applicable to other settings or groups (Saunders *et al*., 2012).

*Reliability* of a research study is achieved when the researcher's data collection techniques and analytical measures produce constant results when they were replicated by another researcher or on a different occasion (Saunders *et al.*, 2012). When a test measures the same thing repeatedly, and the outcomes stays the same, reliability is achieved (Van Zyl, 2014). Furthermore, due to the small sample size in this study, no measure of internal consistency was computed through Cronbach's coefficient alpha. Because this study was both exploratory and descriptive, follow-up studies are necessary to determine the reliability of the results.

Table 4.6 identifies a number of threats that can influence the reliability of the study.

**Table 4.6 Threats to reliability**

| Threat | Definition and explanation |
|---|---|
| **1.Participant error** | Any factor that negatively alters the way a participant performs. For example, requesting a participant to complete the questionnaire picking a less sensitive time, such as his or her lunch break. This may affect the manner in which he or she responds. |
| **2.Participant bias** | Any factor that contains a false response, for example performing an interview in an open space, which may cause participants to provide falsely positive answers because they are concerned that they might be overheard, instead of retaining their anonymity. |
| **3.Researcher error** | Any factor that changes the researcher's interpretation, for example, a tired or unprepared researcher could misinterpret some of the subtle meanings of his or her interviewees. |
| **4.Researcher bias** | Any factor that generates bias in the researcher's recording of responses, for example, a researcher may allow his or her own subjective view or disposition to get in the way of recording and interpreting participants' responses fairly. |

**Source: Saunders *et al.* (2012:192)**

The researcher should avoid these threats to reliability when conducting a study. Categories 1, 2 and 4 were not applicable to this study. Researcher error was minimised by using an online survey, which cannot influence the researcher's interpretation of the data (Saunders *et al.*, 2012).

## 4.8 LIMITATIONS OF THE STUDY

Green logistics is a relatively new concept, and logistics companies in South Africa have only recently started implementing it. Some of the main limitations of the study are listed below.

- The low response rate of the Lime survey. Although initial contact was made with all perspective respondents, explaining the purpose of the questionnaire to them and confirming various email addresses, many respondents did not participate and a response rate of 22.5% was achieved.

- Incomplete surveys. Of the respondents, 15 filled in the questionnaires up to a certain point, but did not complete the entire questionnaire. Therefore, a total of 36 companies participated, with only 21 companies completing the entire questionnaire and 15 companies completing it partially.

- This study also excluded other modes of transport, and only focused on road transport. Sea, air and rail companies were therefore not included in this study.

## 4.9 ETHICAL CONSIDERATIONS

"The ethics of science concerns what is wrong and what is right in the conduct of research" (Mouton, 2001:238). Relations with people, beings and the environment lead to the topic of ethical considerations and moral behaviour (Mouton, 2001). An ethical choice entails consideration for the welfare and rights of various entities (Mouton, 2001). The concept and meaning of ethics may differ from one person to another, as people's moral standards and beliefs are not the same.

Although the concept of ethics is largely debated, De Vos *et al.* (2011:114) define ethics as:

> *Ethics is a set of moral principle which is suggested by an individual or group, is subsequently widely accepted, and which offers rules and behavioural expectations about the most correct conduct towards experimental subjects and respondents, employers, sponsors, other researchers, assistants and students.*

There are some main ethical considerations to be taken into account when conducting research. Some of the main issues identified by De Vos *et al.* (2011) are:

- avoidance of harm;
- voluntary participation;
- informed consent;
- deception of subjects and/or respondents;
- violation of privacy/anonymity/confidentiality;
- denial of treatment;
- compensation;
- debriefing of participants;

- actions and competence of researchers;
- cooperation with contributors and sponsors; and
- publication of the findings.

In the current study, the participants did not experience any physical or emotional harm, and the survey took only 20 minutes of their time and was submitted electronically. The participants were not forced to take part in the survey; participation was voluntary. In order to gain informed consent, a participant information sheet (see Appendix A), with complete and accurate information, was given to each respondent so that they could make an informed decision whether or not to participate (De Vos *et al.*, 2011).

The Unisa participant information sheet contained the following details:

- a brief description of the aim of the study;
- the reason for being invited to participate;
- a statement signifying that participation was voluntary and that there was no penalty or loss of benefit for non-participation;
- the potential benefits and anticipated inconvenience of taking part in the study;
- a statement explaining to which extent confidentiality of information would be maintained and how information would be stored and destroyed;
- incentives for participation as well as ethical approval from Unisa; and
- a brief explanation of how the participant would be informed of the results.

The name and contact details of the company participating are not published and are kept confidential at all times, so the participant's identity is protected. Should the participants request to be informed of the findings, a formal research report with the results can be emailed to them. Ethical clearance was obtained from Unisa's research ethics review committee; see Appendix C for the ethical clearance certificate.

## 4.10 CONCLUSION

In this chapter, the research methodology was discussed and introduced in section 4.1. In section 4.2, the meaning of the research design was discussed. Section 4.3 addressed the classification of research designs, followed by the research objectives (section 4.4) and problem statement (section 4.5) of the study.

The research methodology was explained in well-defined steps according to Figure 4.2 in section 4.6. Step 1 consisted of planning the research design followed by –

- planning the sampling design;
- planning the research instrument;
- collecting the data;
- analysing the data;

Finally, the last step was to formulate the conclusions and present the research findings.

The validity and reliability of the study were discussed in section 4.7, as well as the limitations (section 4.8) and ethical considerations (section 4.9) of the study.

The next chapter will discuss the empirical results and findings of green logistics data of companies in South Africa. The data will be discussed in terms of descriptive and inferential statistical interpretation, an opportunity analysis, a portfolio matrix and cross-tabulations. A best practice framework in green logistics was drafted for companies in South Africa, and this is also reported.

# CHAPTER 5

# EMPIRICAL RESULTS AND FINDINGS OF GREEN LOGISTICS DATA

## 5.1 INTRODUCTION

The primary research objective of the current study was to develop a green logistics framework to assist logistics and transport companies in South Africa by sustaining the practice. This primary research objective was achieved by means of secondary research objectives. The first secondary objective was to identify the main drivers behind implementing green logistics practices. The next secondary objective was to explore the benefits of implementing green logistics practices. The third secondary objective was to determine the barriers preventing companies from implementing green logistics practices. Section 5.2 comprises a report of the descriptive statistical analysis that was used to address the first three objectives of the study.

The fourth secondary objective aimed to explore the green logistics practices of logistics and transport companies located in Gauteng. An opportunity analysis that was conducted to address the fourth secondary objective of the study is reported in section 5.3. A portfolio matrix to interpret the data of the best practices in green logistics management and to address the fourth secondary objective of the study is indicated in section 5.4. The fifth secondary objective was to compare green logistics activities of SMEs and large companies in Gauteng. Inferential statistical analysis is discussed in section 5.5, and cross-tabulations in section 5.6, to achieve the fifth secondary objective of the study. The sixth secondary objective was to provide large companies and SMEs with guidelines on how to implement green logistics practices. The results in the portfolio matrix, discussed in section 5.4, assisted to achieve the sixth secondary objective of the study.

The results of the analysis were used to achieve the primary objective of the study, i.e. a best practice framework in green logistics for companies in South Africa (refer to Figure 5.24) was drafted and is discussed in section 5.7.

In this chapter, the empirical results and findings of the study to achieve the objectives of the study are discussed. The chapter will follow the flow diagram in Figure 5.1 below.

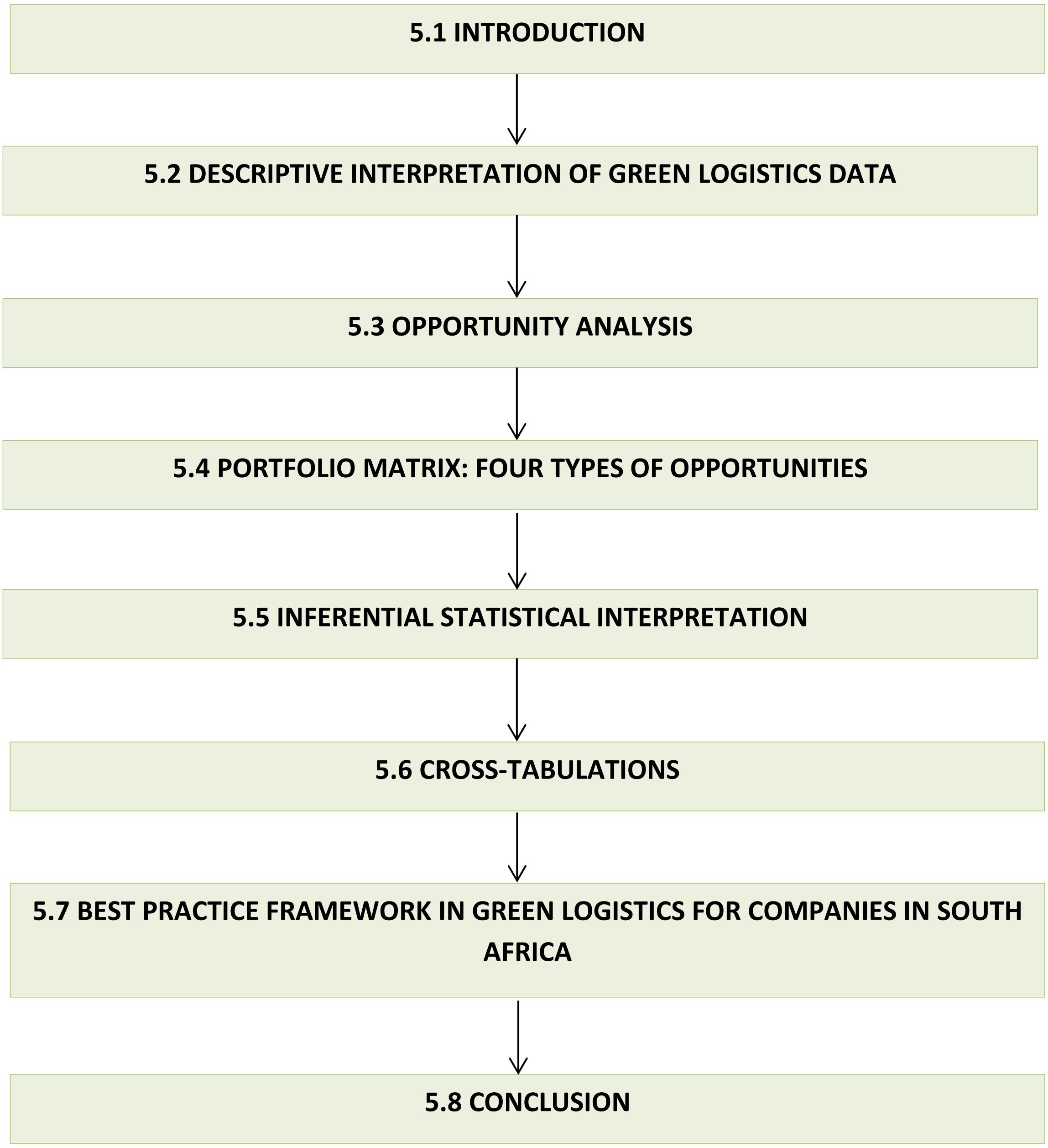


**Figure 5.1: Flow diagram of Chapter 5**

Chapter 4 outlined the research methodology of this study. The research design, research objectives, problem statement, research methodology, validity, reliability, limitations and ethical considerations of the study were discussed in detail. In this chapter, the results and empirical findings of the study are discussed.

As stated in Chapter 4, the research data was collected by means of a survey (Lime), which was sent out to the managers of logistics and transport companies located in Gauteng. A census was conducted, and the sample consisted of 160 companies. The data collection period continued for six weeks, and a response rate of 22.5% was achieved. Out of the 160 companies, 36 companies responded and only 21 companies completed the entire questionnaire.

The data was stored automatically on the Lime survey program, converted into an Excel spreadsheet and exported and interpreted with the use of SSPS v22.

The results of the study are discussed in the following sections:

- descriptive statistical analysis in section 5.2;
- opportunity analysis in section 5.3;
- portfolio matrix in section 5.4;
- inferential statistical analysis in section 5.5;
- cross-tabulations in section 5.6; and
- best practice framework in green logistics for companies in South Africa section 5.7.

## 5.2 DESCRIPTIVE INTERPRETATION OF GREEN LOGISTICS DATA

In Chapter 4, it was stated that descriptive research defines the characteristics of objects, people, groups, organisations or environments, or tries to paint a picture of a given situation. This chapter reports on descriptive statistics used to describe the following:

- section 5.2.1: general information of the companies; and
- section 5.2.2: drivers, benefits and barriers of green logistics.

The results are discussed by making use of tables and graphs.

### 5.2.1 General information

In section A of the questionnaire, the respondents were asked to indicate their position in the company, company turnover per annum, number of employees in the company, number of vehicles, warehouses in square meters and whether they were aware of the concept of green logistics. Question 1 of the questionnaire consisted of the participant information sheet, where the respondents indicated that they accepted and agreed to the terms and conditions of participating in the survey (See Appendix A for the participant information sheet and Appendix B for the questionnaire).

#### *5.2.1.1 Position held in the company*

In question 2 of the questionnaire, respondents were asked to indicate their position in the company. Three options were available, namely lower-level management, middle- and top-level management.

- Lower-level management usually includes positions such as supervisors, assistant managers, foremen and section officers.
- Middle-level management usually includes positions such as plant managers, divisional managers, operational, branch or departmental managers.
- Top-level management consists mostly of chief executive officers (CEOs), chief operating officers (COOs), chief financial officers (CFOs), the board of directors and managing directors.

Table 5.1 and Figure 5.2 below provide the results of the respondents who completed the questionnaire:

**Table 5.1: Frequency and percentage of the position of the respondents**

| | Frequency | Per cent |
|---|---|---|
| Lower-level management | 3 | 8.3% |
| Middle-level management | 21 | 58.3% |
| Top-level management | 12 | 33.3% |
| Total | 36 | 100.0 |

From Figure 5.2 it is clear that 58.3% of the respondents were middle-level managers and 33%, top-level managers. Only 8.3% of the respondents were from lower-level management. This adds to the credibility of the responses to the questions in this study, as the middle- and top-level managers are typically more up to date with environmental practices within the firm than lower-level management.

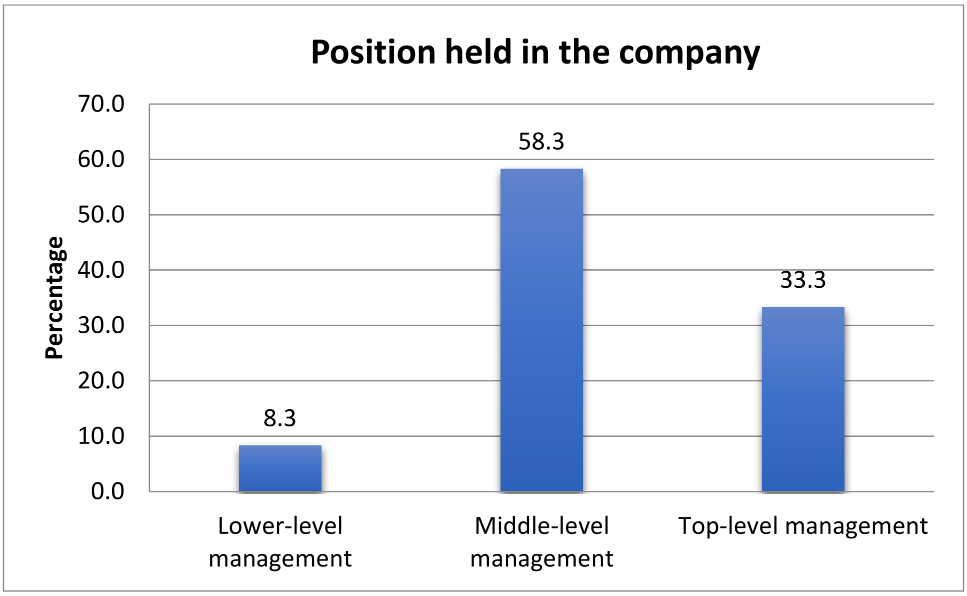


**Figure 5.2: Position of the respondents**

#### *5.2.1.2 Company turnover per annum*

Question 3 of the questionnaire required of respondents to indicate the company turnover per annum.

**Table 5.2: Frequency and percentage of the company turnover per annum**

| | Frequency | Per cent |
|---|---|---|
| Less than R10 million | 2 | 5.6% |
| R10–R100 million | 6 | 16.7% |
| R101–R150 million | 2 | 5.6% |
| R151–R500 million | 4 | 11.1% |
| R500+ million | 21 | 58.3% |
| Unsure | 1 | 2.8% |
| Total | 36 | 100.0 |

Figure 5.3 below illustrates the following:

- 5.6% of the companies' turnover per annum was less than R10 million;
- 16.7% of the companies' turnover per annum was between R10 million and R100 million;
- 5.6% was between R101 and R150 million;
- 11.1% of the companies' turnover per annum was between R151 and R500 million; and
- 58.3% of the companies had a turnover over R500 million rand.

The majority (58.3%) of companies therefore had a turnover of over 500 million, indicating large companies, while SMEs' turnover per annum was less than R26 million (refer to Table 1.1).

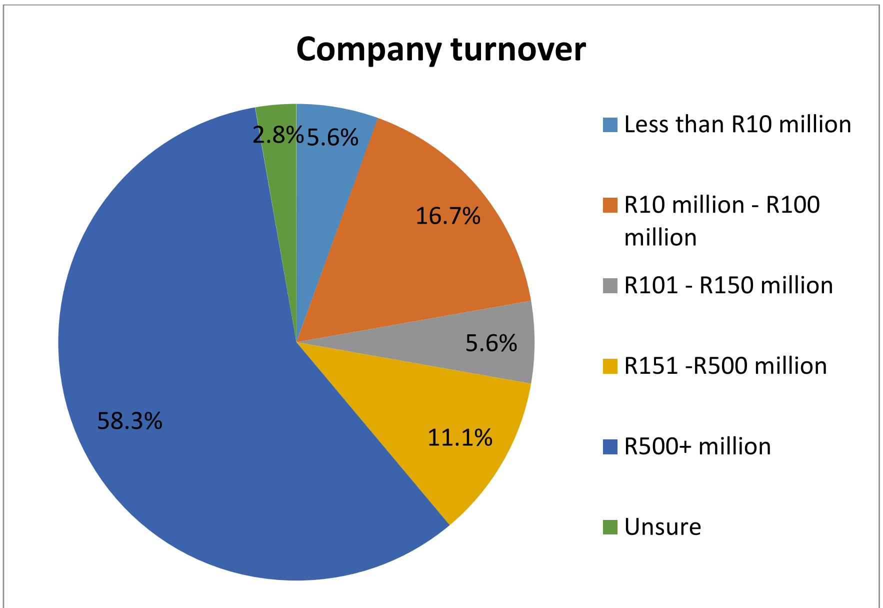


**Figure 5.3: Company turnover per annum**

#### *5.2.1.3 Number of employees in the company*

Question 4 of the questionnaire required of respondents to indicate the number of employees in the company. Table 5.3 and Figure 5.4 below reveal the results.

**Table 5.3: Frequency and percentage of the number of employees in the company**

| Number of employees | Frequency | Percentage |
|---|---|---|
| Fewer than 100 | 9 | 25.0% |
| 100–200 | 3 | 8.3% |
| 201–1000 | 4 | 11.1% |
| 1 001–10 000 | 8 | 22.2% |
| 10 000+ | 12 | 33.3% |
| Total | 36 | 100.0% |

Figure 5.4 below indicates that 25% of the companies had fewer than 100 employees, 8.3% had between 100 and 200 employees and 11.1% had between 201 and 1 000 employees. Of the companies, 22.2% of the companies had between 1 001 and 10 000 employees, and 33.3% had more than 10 000 employees. According to the definition of SMEs provided in Chapter 1, section 1.2, a small and medium-sized company employs 200 fully paid employees. According to Table 5.3, 12 companies (33.3%) that participated in the survey were SMEs and 24 companies (66.7%) were larger companies.

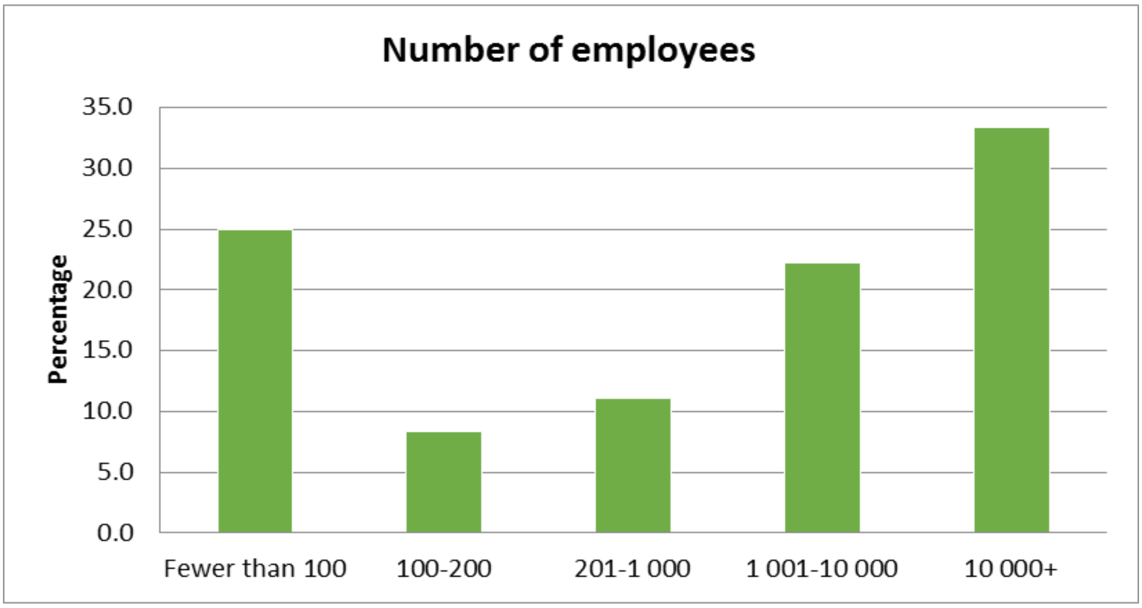


**Figure 5.4: Number of employees in the company**

### *5.2.1.4 Fleet (number of vehicles) in the company*

Question 5 of the questionnaire required of respondents to indicate the number of vehicles in the company.

**Table 5.4: Frequency and percentage of the number of vehicles in the company**

| Number of vehicles | Frequency | Per cent |
|---|---|---|
| Fewer than 10 | 4 | 11.1% |
| 10–100 | 8 | 22.2% |
| 101–1 000 | 10 | 27.8% |
| 1 001–10 000 | 8 | 22.2% |
| 10 000+ | 4 | 11.1% |
| Unsure | 2 | 5.6% |
| Total | 36 | 100.0% |

From Figure 5.5 it is clear that the same percentage of companies (11.1%) had either fewer than 10 trucks or more than 10 000 trucks in their company. Similarly, 22.2% companies had either between 10 and 100 trucks, or between 1 001 and 10 000 trucks. Another 27.8% of the companies owned between 101 and 1 000 trucks and only 5.6% of the respondents were unsure about the number of trucks they owned.

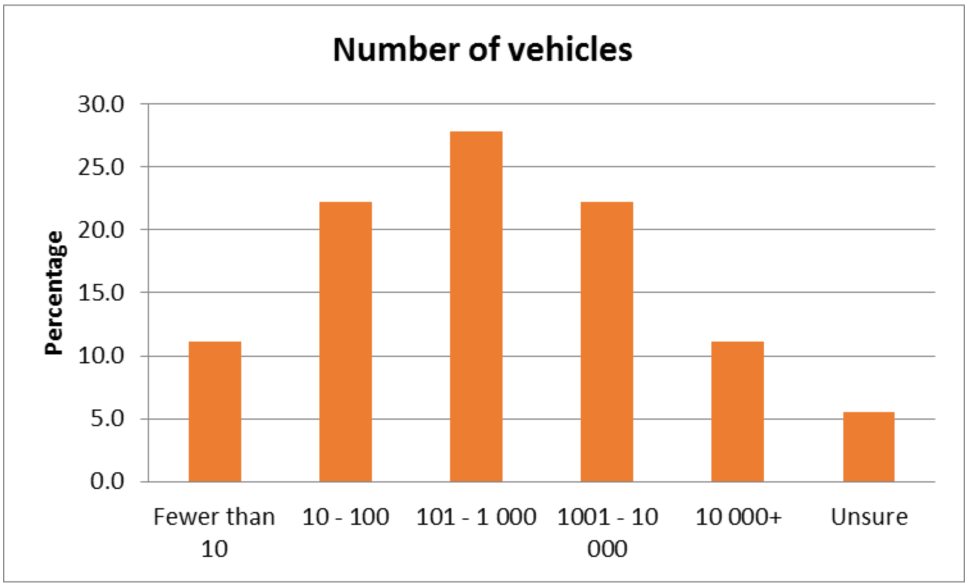


**Figure 5.5: Number of vehicles in the company**

#### *5.2.1.5 Warehouses in square meters*

Question 6 of the questionnaire required of respondents to indicate the square meters of their warehouses. Table 5.5 and Figure 5.6 display the results graphically.

**Table 5.5: Frequency and percentage of warehouses in square meters**

| Warehouses in $m^2$ | Frequency | Per cent |
|---|---|---|
| Less than 10 000 $m^2$ | 7 | 19.4% |
| 10 000–20 000 $m^2$ | 5 | 13.9% |
| 20 001–30 000 $m^2$ | 1 | 2.8% |
| 30 001–40 000 $m^2$ | 3 | 8.3% |
| 40 000+ $m^2$ | 11 | 30.6% |
| Unsure | 9 | 25.0% |
| Total | 36 | 100.0% |

According to Figure 5.6, 13.9% of the companies' warehouses were between 10 000 $m^2$ and 20 000 $m^2$, 2.8% were between 20 001 $m^2$ and 30 000 $m^2$, 8.3% between 30 001 $m^2$ and 40 000 $m^2$, 30.6% over 40 000 $m^2$ and 19.4% indicated their warehouses were less than 10 000 $m^2$. A quarter of the respondents (25%) a fairly high number, indicated they were unsure.

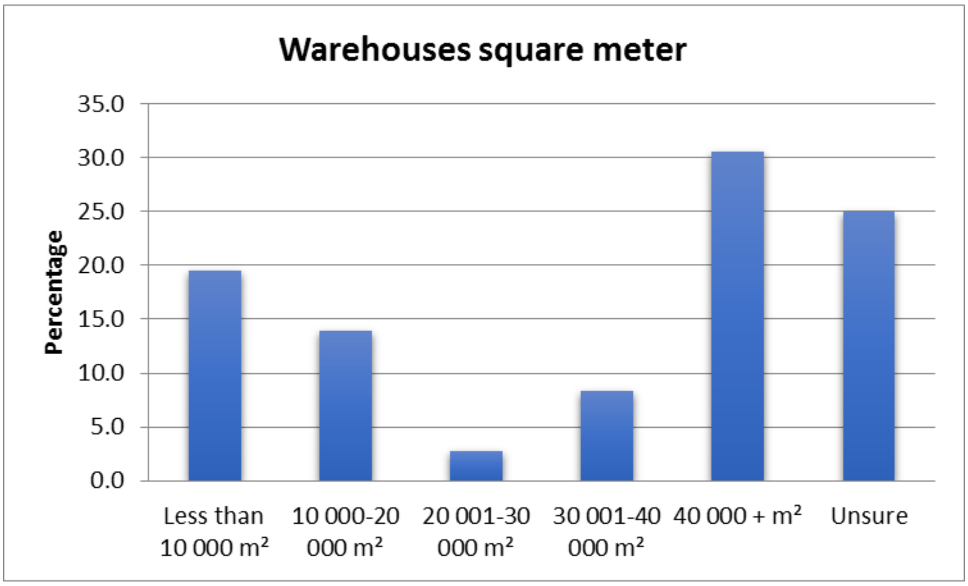


**Figure 5.6: Warehouses in square meters**

#### *5.2.1.6 Status of the company*

Question 7 of the questionnaire required of respondents to indicate the status of the company they worked for. Table 5.6 and Figure 5.7 display the results graphically.

**Table 5.6: Status of the company**

| Status | Frequency | Per cent |
|---|---|---|
| Branch | 2 | 5.6% |
| Head office | 19 | 52.8% |
| Holding company | 3 | 8.3% |
| Independent unit | 1 | 2.8% |
| Other | 2 | 5.6% |
| Subsidiary | 9 | 25.0% |
| Total | 36 | 100.0% |

According to Figure 5.7, more than half of the respondents (52.8%) indicated that they worked at the head office of the company. The second largest group of the respondents (25%) indicated that they were subsidiaries. The rest of the respondents indicated that they were part of a holding company (8%), branch (5.6%) or (2.8%) independent unit.

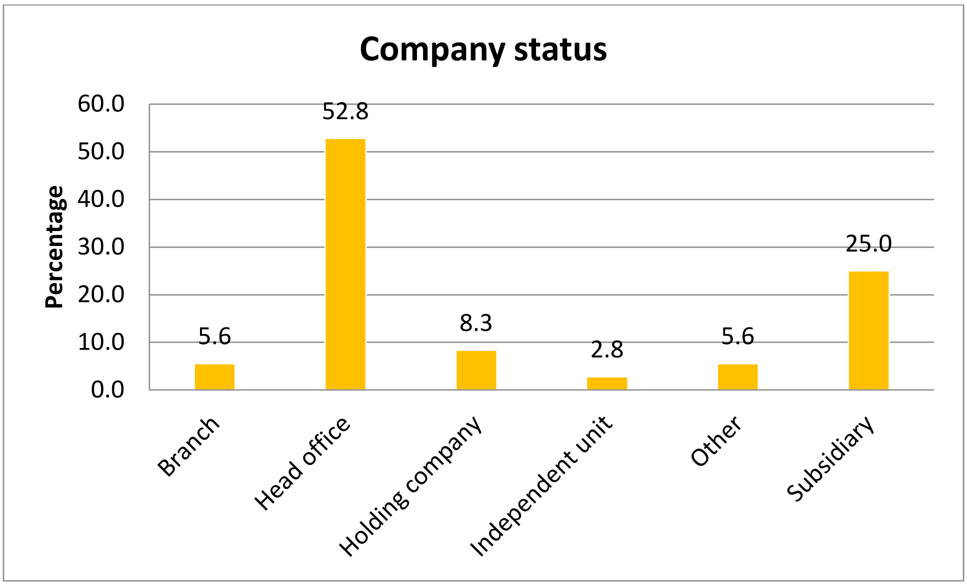


**Figure 5.7: Status of the company**

#### 5.2.1.7 *Awareness of green logistics*

The final question in section A of the questionnaire required of respondents to indicate whether they were aware of the concept of green logistics. This question was specifically asked to estimate how many companies in Gauteng were aware of green logistics. The results are presented in Table 5.7 and Figure 5.8 below.

**Table 5.7: Awareness of green logistics**

| | Frequency | Per cent |
|---|---|---|
| No | 8 | 22.2% |
| Yes | 28 | 77.8% |
| Total | 36 | 100.0% |

According to Figure 5.7 below, the majority of the respondents (77.8%) were aware of the concept of green logistics while 22.2% indicated that they were not aware of the concept of green logistics.

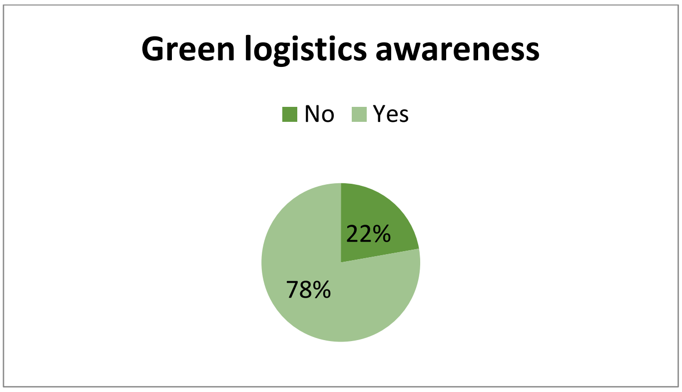


**Figure 5.8: Awareness of green logistics**

According to the results of the demographics questions in section A of the questionnaire, the highest category frequency (in %) of each question is summarised below to indicate the profile of most respondents.

- 58.3% of middle-level managers completed the questionnaire;
- 58.3% of the companies had a turnover over R500 million;
- 33.3% of the companies employed more than 10 000 employees;
- 27.8% of the companies owned between 101 and 1 000 vehicles;
- 30.6% of the companies warehouses were over 40 000 $m^2$;

- 52.8% of the respondents worked at the head office; and
- 78% of the companies were aware of green logistics.

### 5.2.2 Drivers, benefits and barriers of green logistics

Section B of the questionnaire was divided into three subsections, namely the drivers, benefits and barriers of green logistics. The results of each subsection are discussed in more detail to achieve the first three secondary objectives of the study, namely –

- to identify the main drivers behind implementing green logistics practices;
- to explore the benefits of implementing green logistics practices; and
- to determine the barriers preventing companies from implementing green logistics practices.

In section B of the questionnaire, the respondents were required to rate the importance of each driver/benefit/barrier according to the 5-point importance scale ranging from 1 to 5 where 1 = not important at all, 2 = of little importance, 3 = somewhat important, 4 = very important and 5 = extremely important.

#### *5.2.2.1 Drivers of green logistics*

The mean value for each driver gives an indication of the importance of the drivers for all respondents. Table 5.8 below represents the mean value for each driver (see Appendix E, page 261 to 265 for the variable frequency data of the drivers of green logistics).

**Table 5.8: Mean values for the drivers of green logistics**

| *Item* | *Drivers of green logistics* | *Mean* |
|---|---|---|
| D1 | Improving public relations | 3.89 |
| D2 | Improving customer relations | 4.19 |
| D3 | Financial return on investment (ROI) | 3.92 |
| D4 | Part of corporate social responsibility (CSR) | 4.14 |
| D5 | Decreasing fuel bills | 4.39 |
| D6 | Increasing supply chain efficiency | 4.33 |

| *Item* | *Drivers of green logistics* | *Mean* |
|---|---|---|
| D7 | Gaining competitive advantage | 4.44 |
| D8 | Desire to be thought a leader in sustainability | 4.19 |
| D9 | Compliance with government regulations | 4.33 |
| D10 | Rising costs of transportation | 4.31 |
| D11 | Improving corporate image | 4.19 |
| D12 | Satisfying customer requirements | 4.23 |
| D13 | Decreasing risk | 4.08 |
| D14 | Improving investor relations | 3.83 |
| D15 | Rising cost of fuel | 4.42 |
| D16 | Optimising logistics flow | 4.26 |
| D17 | Reducing logistics costs | 4.47 |
| D18 | Differentiating from competitors | 4.44 |
| D19 | Establishing alternative networks | 3.97 |

Figure 5.9 shows the mean values graphically and the following conclusions can be made:

The respondents rated *reducing logistics costs* (D17) as the main driver for implementing green logistics practices with a mean value of 4.47. This was perceived as the main incentive for companies to implement green logistics practices.

Reducing logistics costs was followed by:

- *differentiating from competitors* (D18) and *gaining a competitive advantage* (D7) together ranked as the two second-most important drivers, both with a mean value of 4.44;
- *rising cost of fuel* (D15) ranked as the third-most important driver with a mean value of 4.42;
- *decreasing fuel bills* (D5) ranked as the fourth-most important driver with a mean value of 4.39;

- *increasing supply chain efficiency* (D6) and *compliance with government regulations* (D9) together ranked as the two fifth-most important drivers, both with a mean value of 4.33.

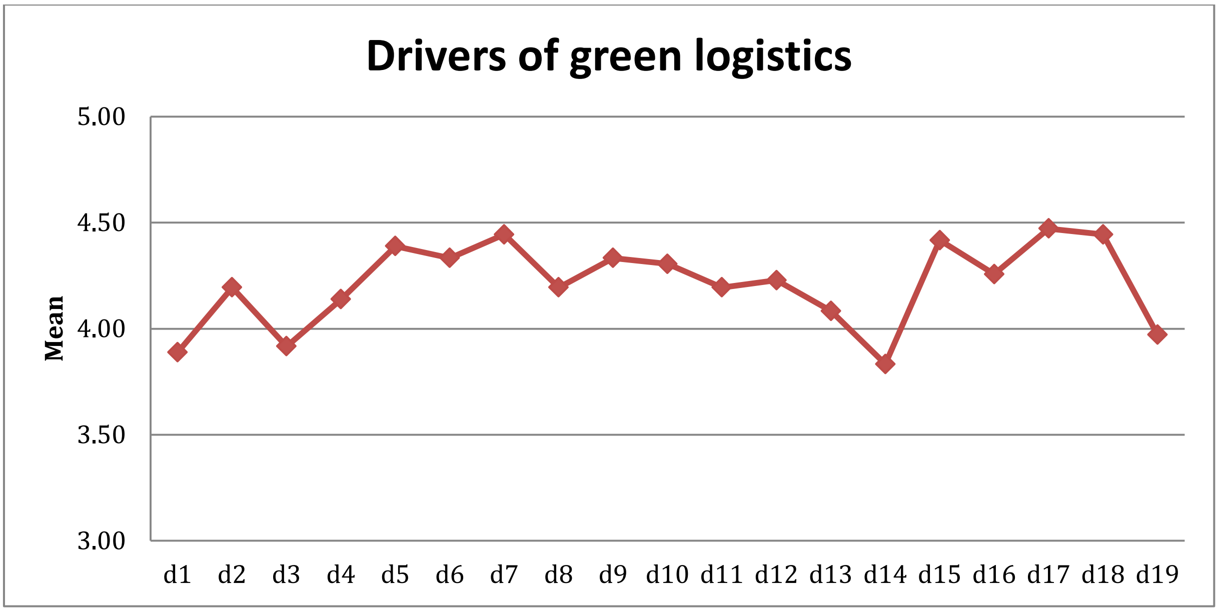


**Figure 5.9: Mean values of the drivers of green logistics**

The drivers with the lowest scores and perceived as the least important were:

- *improving investor relations* (D14) – ranked as the least important driver with a mean value of 3.83; and
- *improving public relations* (D1) – ranked as the second-least important driver with a mean value of 3.89.

#### *5.2.2.2 Benefits of green logistics*

The mean value for each benefit provides an indication of the importance of the benefits for all respondents. Table 5.9 below depicts the mean value of each benefit (see Appendix E, page 265 to 270 for the variable frequency data of the benefits of green logistics).

**Table 5.9: Mean values for benefits of green logistics**

| *Item* | *Benefits of green logistics* | *Mean values* |
|---|---|---|
| B1 | Improving brand image | 4.30 |

| *Item* | *Benefits of green logistics* | *Mean values* |
|---|---|---|
| B2 | Satisfying customer requirements | 4.18 |
| B3 | Differentiating from competitors | 4.21 |
| B4 | Reducing overall business costs | 4.39 |
| B5 | Enhancing corporate social responsibility | 4.39 |
| B6 | Improving profits | 4.39 |
| B7 | Establishing a competitive advantage | 4.45 |
| B8 | Reducing waste/improve disposal | 4.33 |
| B9 | Optimising logistics flow | 4.06 |
| B10 | Expanding to new markets | 4.09 |
| B11 | Reducing emissions | 4.45 |
| B12 | Developing new products | 4.00 |
| B13 | Winning new customers | 4.09 |
| B14 | Reducing logistics costs | 4.34 |
| B15 | Optimising manufacturing | 3.75 |
| B16 | Reducing manufacturing costs | 3.81 |
| B17 | Improving visibility of green supply chain drivers | 4.25 |
| B18 | Increasing the use of recyclables | 4.22 |
| B19 | Improving fuel efficiency | 4.50 |
| B20 | Reduce use of toxic materials | 4.22 |
| B21 | Improving employee satisfaction | 4.09 |

Figure 5.10 depicts the mean values graphically, and certain conclusions could be drawn.

The respondents rated **improving fuel efficiency** (B19) as the main benefit for implementing green logistics practices with a mean value of 4.50. This was perceived as the main benefit encouraging companies to implement green logistics practices.

*Improving fuel efficiency* was followed by:

- *reducing emissions* (B11) and *establishing a competitive advantage* (B7) – ranked as the two second-most important benefits both with a mean value of 4.45;
- *improving profits* (B6), *enhancing corporate social responsibility* (B5), and *reducing overall business costs* (B4) – ranked as the three third-most important benefits with mean values of 4.39;
- *reducing logistics costs* (B14) – ranked as the fourth-most important benefit with a mean value of 4.34; and
- *reducing waste/improving disposal* (B8) – ranked as the two fifth-most important benefit with a mean value of 4.33.

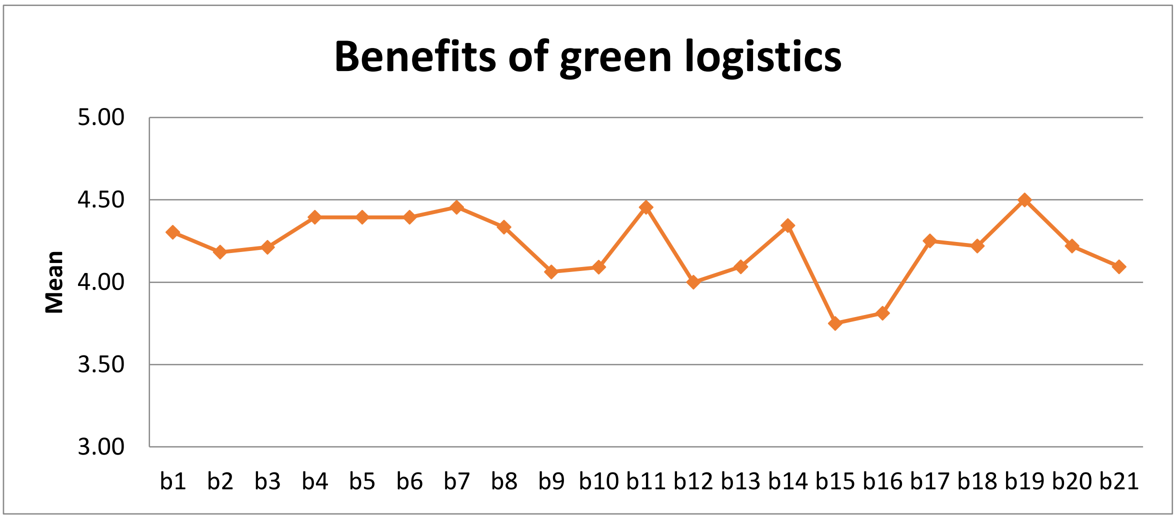


**Figure 5.10: Mean values of the benefits of green logistics**

The benefits with the lowest scores and perceived as the least important were:

- *optimising manufacturing* (B15) – ranked as the least important benefit with a mean value of 3.75.
- *reducing manufacturing costs* (B16) – ranked as the second least important benefit with a mean value of 3.81.

#### *5.2.2.3 Barriers of green logistics*

The mean value for each barrier provides an indication of the importance of the barriers for all respondents. Table 5.10 represents the mean values for the barriers of green logistics below (see Appendix E, page 271 to 275 for the variable frequency data of the barriers of green logistics).

**Table 5.10: Mean values for barriers of green logistics**

| *Item* | *Barriers of green logistics* | *Mean* |
|---|---|---|
| Ba1 | Lack of integration technology systems | 3.62 |
| Ba2 | Lack of acceptance of advancement in new technology | 3.62 |
| Ba3 | Poor organisational culture in green supply chain management (GSCM) | 3.64 |
| Ba4 | Lack of skilled human resource professionals in sustainability and GSCM | 3.93 |
| Ba5 | Uncertainty and competition in market | 3.86 |
| Ba6 | Lack of government incentive system for GSCM practitioners | 3.96 |
| Ba7 | Poor implementation of green practices within a supply chain | 3.96 |
| Ba8 | Lack of top-level management commitment | 4.00 |
| Ba9 | Cost of implementation for GSCM | 3.89 |
| Ba10 | Lack of flexibility of suppliers to change towards GSCM | 3.82 |
| Ba11 | Customer's unawareness towards GSCM products and services | 3.79 |
| Ba12 | Lack of knowledge and experience | 4.18 |
| Ba13 | Lack of green architects, consultants, green developers, contractors in the region | 3.64 |
| Ba14 | Lack of training in GSCM | 4.11 |
| Ba15 | Lack of internal sustainability audits within the organisation | 3.85 |
| Ba16 | Lack of external sustainability audits for suppliers and contractors | 3.96 |
| Ba17 | Lack of sustainability certification like ISO 14001 | 3.71 |
| Ba18 | Lack of professional treatment and long-term contracts for adopting GSCM from government | 4.07 |
| Ba19 | Lack of management initiatives for transport and logistics | 4.04 |
| Ba20 | Lack of energy management and waste management of the organisation | 3.68 |

Figure 5.11 depicts the mean values graphically and certain conclusions were drawn.

The respondents rated **lack of knowledge and experience** (Ba12) as the main barrier for implementing green logistics practices with a mean value of 4.18. This was perceived as the main barrier preventing companies from implementing green logistics practices.

*Lack of knowledge and experience* was followed by:

- *lack of training in green supply chain management* (GSCM) (Ba14) – ranked as the second-most important barrier with a mean value of 4.11;
- *lack of professional treatment and long-term contracts for adopting GSCM from government* (Ba18) – ranked as the third-most important barrier with a mean value of 4.07;
- *lack of management initiatives for transport and logistics* (Ba19) – ranked as the fourth-most important barrier with a mean value of 4.04; and
- *lack of top-level management commitment* (Ba8) – ranked as the fifth-most important barrier with a mean value of 4.00.

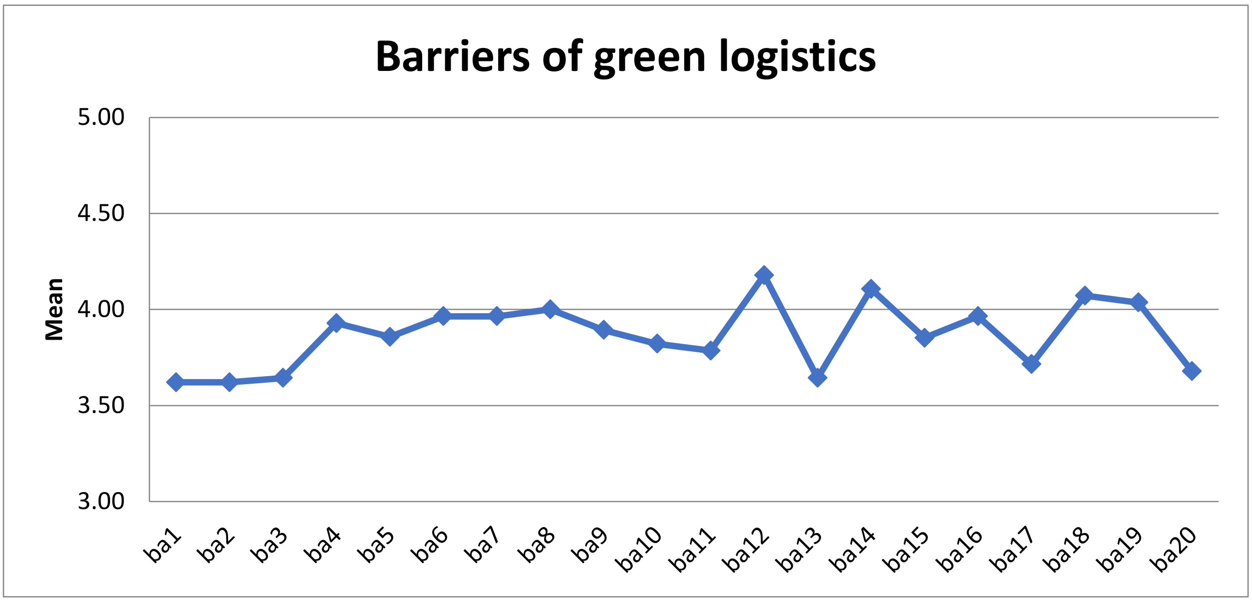


**Figure 5.11: Mean values of the barriers of green logistics**

The barriers with the lowest scores and perceived as the least important were *lack of integration technology systems* (Ba1) and *lack of acceptance of advancement in new technology* (Ba2), which ranked as the least important barriers, both with mean values of 3.62.

### 5.2.3 Summary of the drivers, benefits and barriers of green logistics

In this section, some of the results of section B are summarised below.

#### *5.2.3.1 Summary of the drivers of green logistics*

The respondents of the questionnaire rated the following five incentives, in a ranking order from highest to lowest, as the main drivers for implementing green logistics practices in Gauteng:

- *reducing logistics costs* (D17) – with a mean value of 4.47;
- *differentiating from competitors* (D18) and *gaining a competitive advantage* (D7) – both drivers with a mean value of 4.44;
- *rising cost of fuel* (D15) – with a mean value of 4.42;
- *decreasing fuel bills* (D5) – with a mean value of 4.39; and
- *increasing supply chain efficiency* (D6) and *compliance with government regulations* (D9) – both drivers with a mean value of 4.33.

Contrary to research by Andiç *et al.* (2012) which identified *legislation* and *economic concerns* as two of the most effective drivers, logistics companies in Gauteng did not see these two drivers of high importance. A possible reason might be that South African government regulations regarding the environment in the form of carbon taxes will only be imposed from 2016 (Cohen, 2014). From an economic perspective, companies will only benefit from green practices once the practices are implemented and very few companies in South Africa were actively implementing green practices at the time of this research.

*Reducing logistics costs*, which was rated as the main driver by the respondents in Gauteng, was also evident in South African research by Göransson and Gustafsson (2014), where **cost savings** was one of the main incentives identified by the managers of large logistics companies. Companies can save costs by reducing total logistics costs. *Reducing logistics costs* was rated as the third-most important driver in research conducted by Bearing Point (2008), therefore it can be assumed that both international and local companies in South Africa view *reducing logistics costs* as one of the main incentives for implementing green practices.

Although the driver *differentiating from competitors* was rated highly among the respondents in the current study, only 11% of the respondents in Bearing Point's (2008) survey thought it was important. A possible reason might be that logistics and transport companies in South Africa are highly competitive due to the low capital cost required for market entry. According to logistics researcher, Mr. Ittmann, there are thousands of small logistics companies competing for each other's customers and services in South Africa (Göransson & Gustafsson, 2014). Implementing green practices might possibly give companies a competitive advantage over companies that are not implementing these practices.

The driver *gaining a competitive advantage* was rated as the third-most important driver in a survey conducted by Aberdeen Group (2008), and it was also rated as very important by the respondents in the current study. Both international and local companies rated this as one of their top five reasons for the implementation of green practices.

The respondents in the survey conducted by Aberdeen Group (2008) identified the **rising cost of fuel** as one of the top five drivers. This correlates with the respondents in the current study who also rated *rising cost of fuel* as one of the top five drivers. Through implementing green practices, an increase in fuel efficiency can be achieved and possible savings on fuel costs (McKinnon *et al.*, 2010).

Although *decreasing fuel bills* was rated among the top five drivers in the current study, the respondents in eyefortransport's (2007) survey rated this driver as only moderately important. Logistics companies in South Africa are under increasing pressure to reduce transportation costs. As indicated in Figure 2.5, transportation costs comprise the biggest cost component of South Africa's total logistics costs. High fuel bills contribute to high transport costs, therefore *decreasing fuel bills* were rated as one of the top five incentives for implementing green practices.

*Increasing supply chain efficiency* and *compliance with government regulations* were rated as the two fifth-most important drivers for the implementation of green logistics practices. Companies in South Africa are aware that carbon taxes will be implemented from 2016; therefore, the necessary practices should be implemented to comply with government regulations, and these practices could also enhance supply chain efficiency.

#### *5.2.3.2 Summary of the benefits of green logistics*

The respondents in the current research rated the following five factors, in a ranking order from highest to lowest, as the main benefits for implementing green logistics practices in Gauteng:

- *improving fuel efficiency* (B19) – with a mean value of 4.50;
- *reducing emissions* (B11) and *establishing a competitive advantage* (B7) – ranked as the two second-most important benefits both with a mean value of 4.45;
- *improving profits* (B6), *enhancing corporate social responsibility* (B5) and *reducing overall business costs* (B4) – ranked as the third-most important benefits with a mean value of 4.39;
- *reducing logistics costs* (B14) – ranked as the fourth-most important benefit with a mean value of 4.34; and
- *reducing waste/improving disposal* (B8) – ranked as the fifth-most important benefit with a mean value of 4.33.

The respondents of this questionnaire rated *improving fuel efficiency* as the main incentive for implementing green practices. Although companies in Gauteng viewed this as very important, only 35% of the respondents in the survey conducted by the Aberdeen Group (2008) thought it was important, as reflected in Table 3.6. As discussed in section 5.2.3.1, logistics companies in South Africa are faced with high transport costs. By improving fuel efficiency, high transport costs could possibly be reduced.

Although *reducing emissions* was rated very highly among the respondents in the current study, only 33% of the respondents in the survey conducted by the Aberdeen Group (2008) thought it was important. As displayed in Table 3.6, international companies rated the *reduction of overall business costs* and *enhancement of CSR* as the top benefits for implementation of green practices. In comparison with a survey study conducted by Bearing Point (2008), respondents in both groups rated *establishing a competitive advantage* as the top five benefits for the implementation of green practices. Therefore, both international and local companies view this benefit of key importance.

*Improving profits* and *enhancement of CSR* supports the survey study conducted by the Aberdeen Group (2008) as depicted in Table 3.6, as this was rated as the top five benefit by the respondents in the current study as well as internationally.

**Reducing logistics costs** was ranked as the fourth-most important benefit by companies in Gauteng, whilst *reducing waste* and *improving disposal* were ranked as the two fifth-most important benefits for implementing green logistics practices. From the benefits listed above, it is clear that participating companies in Gauteng were aware of the benefits of implementing green logistics practices. Although there are many benefits of implementing green logistics practices (McKinnon *et al.*, 2010), companies will have to implement these practices to a certain extent to achieve certain benefits.

#### *5.2.3.3 Summary of the barriers of green logistics*

The respondents in the current research rated the following five factors, in a ranking order from highest to lowest, as the main barriers for implementing green logistics practices in Gauteng:

- *lack of knowledge and experience* (Ba12) – with a mean value of 4.18;
- *lack of training in GSCM* (Ba14) – with a mean value of 4.11;
- *lack of professional treatment* and *long-term contracts for adopting GSCM from government* (Ba18) – with a mean value of 4.07;
- *lack of management initiatives for transport and logistics* (Ba19) – with a mean value of 4.04; and
- *lack of top-level management commitment* (Ba8) – with a mean value of 4.00.

From the barriers above, it is clear that the participating managers of logistics and transport companies felt they had a lack of knowledge and experience regarding green practices. Managers of large companies and SMEs should attend regular training initiatives and workshops regarding the implementation of green logistics practices to be able to encourage their employees to be more environmentally aware. Managers should also be committed to enforce environmental strategies and engage in various green activities to establish a culture of environmental awareness in the company. Göransson and Gustafsson (2014) identified other barriers which relate to South African companies as discussed in section 3.4. Some of these barriers are:

- education regarding green logistics needs to be improved;
- poor quality of roads in rural areas needs to be improved;
- South Africa's infrastructure is problematic;
- cleaner fuel that is not available in South Africa; and
- the high cost of technology is inhibiting.

In this section, a summary of the results of the drivers, benefits and barriers of green logistics was discussed. Some of the main issues in literature regarding the drivers, benefits and barriers were highlighted. In the next section, the opportunity analysis with regard to the best practices in green logistics management to address the fourth secondary objective, is discussed.

## 5.3 OPPORTUNITY ANALYSIS

### 5.3.1 Section C: Best practices in green logistics management

In this section, the analysis of Section C of the questionnaire is discussed with regard to best practices in green logistics management in terms of the importance and difficulty of implementing the practice. This section carries a discussion of the fourth secondary objective of the study, namely *to explore green logistics practices of logistics and transport companies located in Gauteng.*

These practices can be implemented at six hierarchical levels, and are discussed as follows:

- strategic best practices (section 5.3.1.1)
- tactical best practices (section 5.3.1.2)
- operational best practices (section 5.3.1.3)
- organisational best practices (section 5.3.1.4)
- technical best practices (section 5.3.1.5)
- internal best practices (section 5.3.1.6)

This was done by means of an opportunity analysis.

#### *5.3.1.1 Strategic best practices*

In this section, the importance to implement strategic best practices and the difficulty of implementing each practice are discussed. Table 5.11 below depicts the code of each strategic best practice (see Appendix E, page 276 to 280 for the variable frequency data of the strategic best practices).

**Table 5.11: Codes depicting strategic best practices**

| |
|---|
| St1 = Change of truck fleets |
| St3 = Standardisation of truck sizes |
| St5 = Creation of distribution centres |
| St7 = Sustainable carrier selection |
| St9 = Automatic warehousing system (AWS) |
| St11 = Facility design and construction |
| St13 = Carbon footprint assessment |
| St15 = Green customer criteria gathering |
| St17 = Introduction of tracking and tracing systems |

Table 5.12 indicates the mean values for the importance and difficulty to implement strategic best practices.

**Table 5.12: Mean values for the importance and difficulty to implement strategic best practices**

| | **St1** | **St3** | **St5** | **St7** | **St9** | **St11** | **St13** | **St15** | **St17** |
|---|---|---|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 3.78 | 2.78 | 3.73 | 4.13 | 3.65 | 3.96 | 4.35 | 3.91 | 4.48 |
| **Difficulty** to implement these practices | 3.70 | 3.30 | 3.50 | 3.48 | 3.65 | 3.78 | 3.22 | 3.22 | 3.43 |

The radar graph in Figure 5.12 shows the importance and difficulty of implementing strategic best practices.

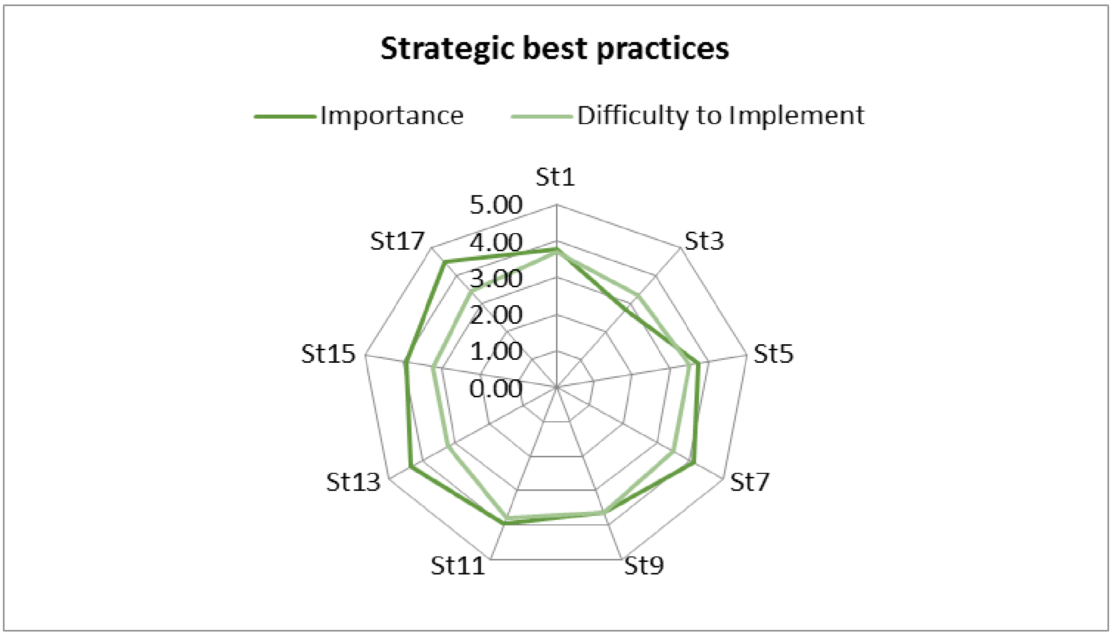


**Figure 5.12: Importance/difficulty of implementing strategic best practices**

From the radar graph, the following conclusions can be made:

- *Introduction of tracking and tracing systems* (St17) was rated as the most important strategic best practice to implement with a mean value of 4.48, but it can be moderately difficult to implement with a mean value of 3.43. This can be due to the high amount of capital needed to implement these systems.

- *Carbon foot print assessment* (St13) was rated as the second most important strategic best practice with a mean value of 4.36. However, companies found it moderately difficult to implement it with a mean value of 3.22. This can be a result of a lack of industry experts in the field conducting carbon footprint assessments for companies in South Africa.

- Facility design and construction (St11) was rated the most difficult practice to implement with a mean value of 3.70, and an importance mean value of 3.96. Although companies tended to find this practice very important, they also tended to find it very difficult to implement. Companies, especially SMEs, may find it hard to change the design and construction of their facilities as finances is a major problem that they face.

- *Change of truck fleets* (St1) also had a mean value of 3.70 and an importance mean value of 3.78. The respondents tended to see this practice as moderately to very difficult to implement, and very important. Changing of truck fleets requires a large amount of capital, so many companies may see this as unnecessary.

#### *5.3.1.2 Tactical best practices*

In this section, the importance to implement tactical best practices and the difficulty of implementing each practice are discussed below. Table 5.13 depicts the code of each tactical best practice (see Appendix E, page 281 to 286 for the variable frequency data of the tactical best practices).

**Table 5.13: Codes depicting tactical best practices**

| |
|---|
| Ta1 = Palletisation *of cargo* |
| Ta3 = Freight consolidation |
| Ta5 = Modal choice |
| Ta7 = Selection of different equipment |
| Ta9 = Reconditioning and reusing pallets and containers |
| Ta11 = Disposing of products |
| Ta13 = Environmental certifications |
| Ta15 = Pallet and container pooling systems |
| Ta17 = Use of different packaging technologies to reduce contamination |

In Table 5.14, the mean values for the importance and difficulty to implement tactical best practices are summarised.

**Table 5.14: Mean values for the importance and difficulty to implement tactical best practices**

| | Ta1 | Ta3 | Ta5 | Ta7 | Ta9 | Ta11 | Ta13 | Ta15 | Ta17 |
|---|---|---|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 3.48 | 3.96 | 3.65 | 3.91 | 3.78 | 3.17 | 4.13 | 3.43 | 3.65 |
| **Difficulty** to implement these practices | 2.65 | 3.43 | 2.91 | 3.43 | 2.78 | 2.83 | 3.70 | 2.87 | 3.30 |

The radar graph in Figure 5.13 below shows the importance and difficulty of implementing tactical best practices.

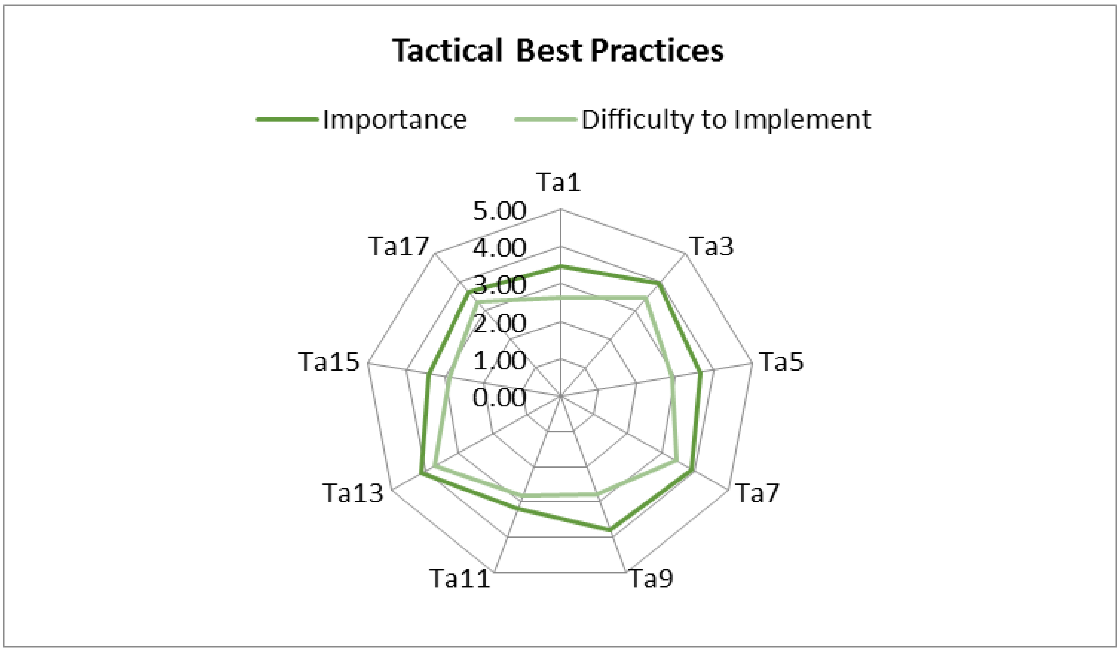


**Figure 5.13: Importance/difficulty of implementing tactical best practices**

From the radar graph, the following conclusions can be made:

- *Environmental certifications* (Ta13) were rated as the most important tactical best practice to implement with a mean value of 4.13. Although this had the highest importance mean value, environmental certifications were also rated as the most difficult practice to implement with a mean value of 3.70.

Companies awarded environmental certifications can use such certification to attract new clients, improve their corporate image and be seen as leaders in sustainability.

- *Freight consolidation* (Ta3) was rated as the second-most important tactical best practice to implement with a mean value of 3.96, and difficult to implement with a mean value of 3.43. This practice can be seen as very important, but moderately difficult to implement. Freight consolidation can be achieved by large and small companies by bundling various small shipments together.

- *Selection of different equipment* (Ta7) was also rated as the second-most difficult tactical practice to implement with a mean value of 3.43. Although having a high importance value of 3.91, many companies may find it moderately difficult to implement because of equipment available for them to choose from.

#### *5.3.1.3 Operational best practices*

In this section, the importance to implement operational best practices and the difficulty of implementing each practice are discussed. Table 5.15 depicts the code of each operational best practice (see Appendix E, page 286 to 292 for the variable frequency data of the operational best practices).

**Table 5.15: Codes representing operational best practices**

| |
|---|
| Op1 = Using clean vehicles |
| Op3 = Fuel efficiency |
| Op5 = Load optimisation |
| Op7 = Clean material handling equipment |
| Op9 = Energy efficiency |
| Op11 = Process optimisation |
| Op13 = Minimisation of inventories |
| Op15 = On-site recycling, packaging recycling, use of ecological materials |
| Op17 = Environmental footprint reports |
| Op19 = Use of tracking and tracing systems to improve operations' performance |
| Op21 = Carbon footprint assessment |

In Table 5.16, the mean values for the importance and difficulty to implement operational best practices are summarised.

**Table 5.16: Mean values for the importance and difficulty to implement operational best practices**

| | **Op1** | **Op3** | **Op5** | **Op7** | **Op9** | **Op11** | **Op13** | **Op15** | **Op17** | **Op19** | **Op21** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 4.09 | 4.48 | 4.35 | 3.83 | 4.48 | 4.43 | 4.17 | 3.70 | 3.83 | 4.35 | 4.17 |
| **Difficulty** to implement these practices | 2.35 | 3.13 | 3.30 | 2.52 | 3.22 | 3.65 | 3.57 | 3.22 | 3.17 | 3.30 | 3.26 |

The radar graph in Figure 5.14 shows the importance and difficulty of implementing operational best practices.

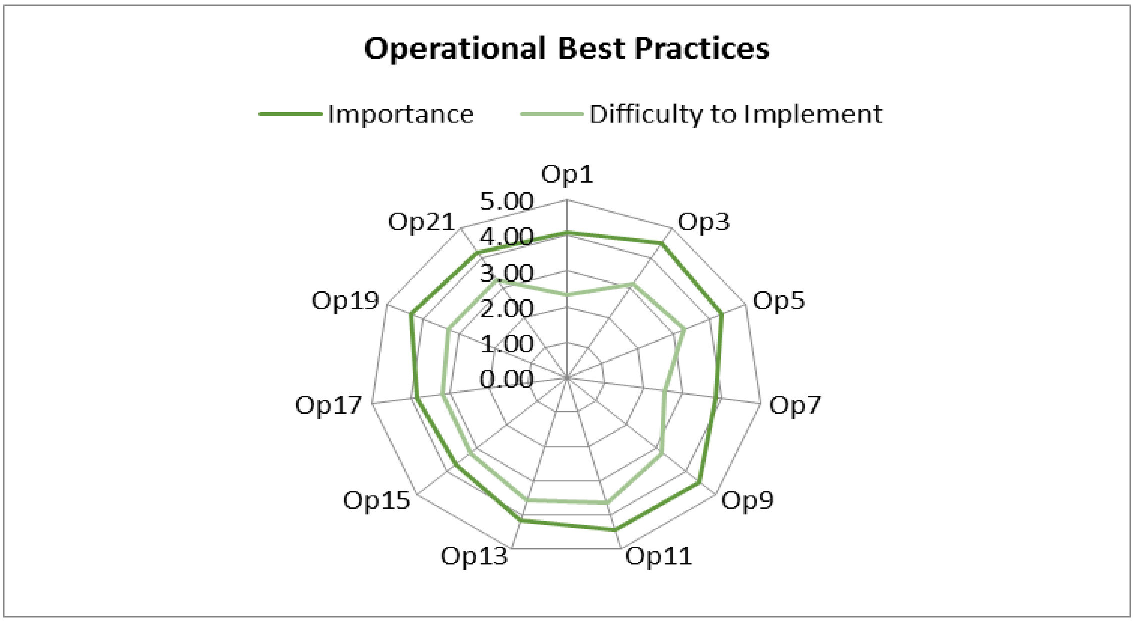


**Figure 5.14: Importance/difficulty of implementing operational best practice**

From the radar graph, the following conclusions can be made:

- *Fuel efficiency* (Op3) and *Energy efficiency* (Op9) were rated as the most important operational best practices to implement with the same mean value of 4.48. The difficulty of implementing fuel efficiency had a mean value of 3.13 and energy efficiency, 3.22. Companies viewed fuel efficiency and energy efficiency both as very important, and moderately difficult or almost very easy to implement.

- *Process optimisation* (Op11) was rated as the second-most important operational practice to implement with a mean value of 4.43. Although process optimisation was seen as very important, it was also rated as very difficult to implement, with a mean value of 3.65.

- *Minimisation of inventories* (Op13) was rated as the second-most difficult practice to implement with a mean value of 3.57, and seen as very important with a mean value of 4.17.

#### *5.3.1.4 Organisational best practices*

In this section, the importance to implement organisational best practices and the difficulty of implementing each practice are discussed below. Table 5.17 represents the code of each organisational best practice (see Appendix E, page 292 to 300 for the variable frequency data of the organisational best practices).

**Table 5.17: Codes representing organisational best practices**

| |
|---|
| Or1 = *Optimal* routing planning |
| Or3 = Double stacking |
| Or5 = Moving a national DC operation to a regional DC operation |
| Or7 = Night-time deliveries |
| Or9 = Optimising load fill |
| Or11 = Reducing packaging |
| Or13 = Developing relationships |
| Or15 = More frequent deliveries |
| Or17 = Distribution consolidation |
| Or19 = Multimodal services, e.g. road to rail then to road again |
| Or21 = Development of a strategic environmental plan |
| Or23 = Implementation of an environmental management system (EMS) |
| Or25 = Integrated management system (IMS) |
| Or27 = Communication |
| Or29 = Transport collaboration |
| Or31 = Fuel management for transport operators, training of drivers, new technology |

Table 5.18 indicates the mean values for the importance and difficulty to implement organisational best practices.

**Table 5.18: Mean values for the importance and difficulty to implement organisational best practices**

| | Or1 | Or3 | Or5 | Or7 | Or9 | Or11 | Or13 | Or15 | Or17 | Or19 | Or21 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 4.67 | 3.57 | 3.76 | 4.19 | 4.52 | 3.67 | 4.62 | 3.62 | 4.19 | 3.86 | 4.38 |
| **Difficulty** to implement these practices | 3.29 | 2.90 | 3.76 | 3.48 | 3.05 | 3.33 | 3.0 | 3.05 | 3.57 | 3.86 | 3.24 |

| | Or23 | Or25 | Or27 | Or29 | Or31 |
|---|---|---|---|---|---|
| **Importance** of implementing the practices | 4.29 | 4.19 | 4.57 | 4.38 | 4.81 |
| **Difficulty** to implement these practices | 3.57 | 3.81 | 2.90 | 3.33 | 3.33 |

The radar graph in Figure 5.15 shows the importance and difficulty of implementing organisational best practices.

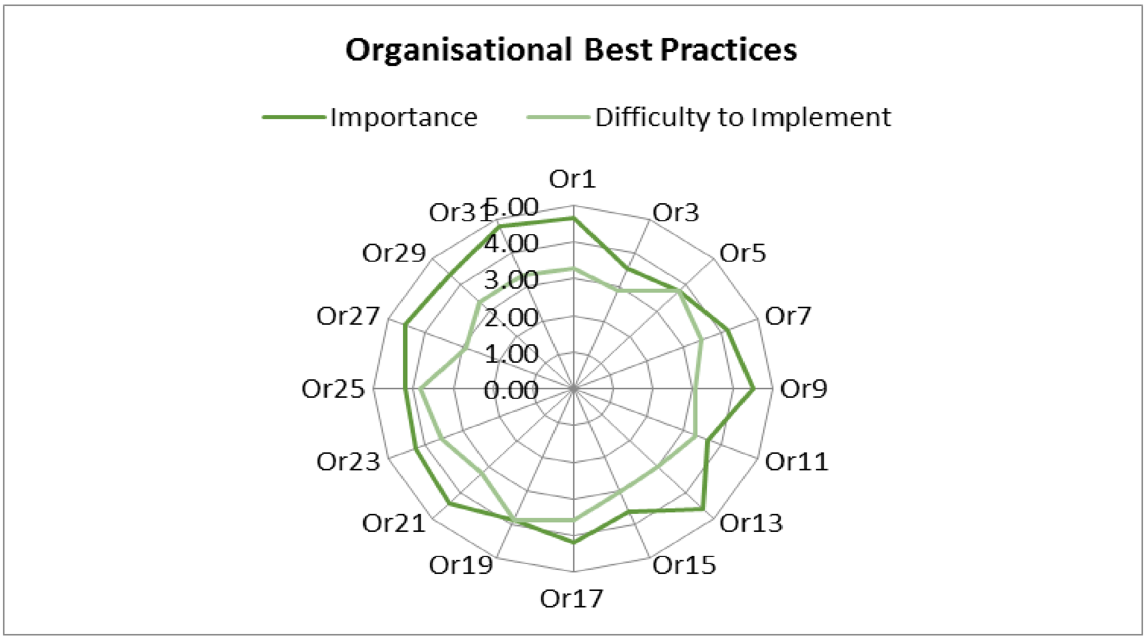


**Figure 5.15: Importance/difficulty of implementing organisational best practices**

From the radar graph, the following conclusions can be made:

- *Fuel management for transport operators, training of drivers and new technology* (Or31) was rated as the most important organisational best practice to implement with a mean value of 4.81, thus indicating that Or31 is seen as extremely important, while moderately difficult to implement with a mean value of 3.33.

- *Optimal routing planning* (Or1) was rated as the second-most important organisational practice with a mean value of 4.7, and a difficulty to implement value of 3.29.

- Multimodal services, e.g. *Road to rail then to road again* (Or19) were rated as the most difficult practice to implement with a mean value of 3.86. Although this practice was seen as very difficult to implement, it was also rated as very important with a mean value of 3.86.

- *Integrated management system* (IMS) (Or25) was rated as the second-most difficult practice to implement with a mean value of 3.81, and rated as very important with a mean value of 4.19.

#### *5.3.1.5 Technical best practices*

In this section, the importance to implement technical best practices and the difficulty of implementing each practice are discussed. Table 5.19 represents the code of each technical best practice (see Appendix E, page 300 to 309 for the variable frequency data of the technical best practices).

**Table 5.19: Codes representing technical best practices**

| |
|---|
| Te1 = Installing fleet management systems |
| Te3 = Telematics |
| Te5 = Using fuel-saving devices |
| Te7 = Euro IV lubricating oils |
| Te9 = Installing new washing facilities |
| Te11 = Use of double-deck trailers to replace single-deck trailers |
| Te13 = Use of multimodal transport |
| Te15 = Monitoring fuel consumption |
| Te17 = Use of rainwater for vehicle cleaning |
| Te19 = Exchanging diesel vehicles for electric vehicles |
| Te21 = Satellite tracking |
| Te23 = Load optimisation |
| Te25 = Installing routing software |
| Te27 = Electric forklift trucks instead of diesel |
| Te29 = Installing software to measure, monitor and reduce fuel consumption |
| Te31 = Load-planning software |
| Te33 = Solar roof to save energy |

Table 5.20 shows the mean value for the importance and difficulty to implement technical best practices.

**Table 5.20: Mean values for the importance and difficulty to implement technical best practices**

| | Te1 | Te3 | Te5 | Te7 | Te9 | Te11 | Te13 | Te15 | Te17 | Te19 | Te21 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 4.43 | 3.90 | 4.19 | 3.57 | 3.67 | 2.71 | 4.05 | 4.52 | 3.62 | 3.24 | 4.52 |
| **Difficulty** to implement these practices | 3.14 | 3.14 | 3.14 | 2.90 | 3.43 | 2.95 | 3.62 | 2.48 | 3.05 | 4.05 | 3.05 |

| | Te23 | Te25 | Te27 | Te29 | Te31 | Te33 |
|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 4.43 | 4.29 | 3.67 | 4.29 | 4.10 | 3.19 |
| **Difficulty** to implement these practices | 3.38 | 3.48 | 3.14 | 3.38 | 3.05 | 3.76 |

The radar graph in Figure 5.16 below shows the importance and difficulty of implementing technical best practices.

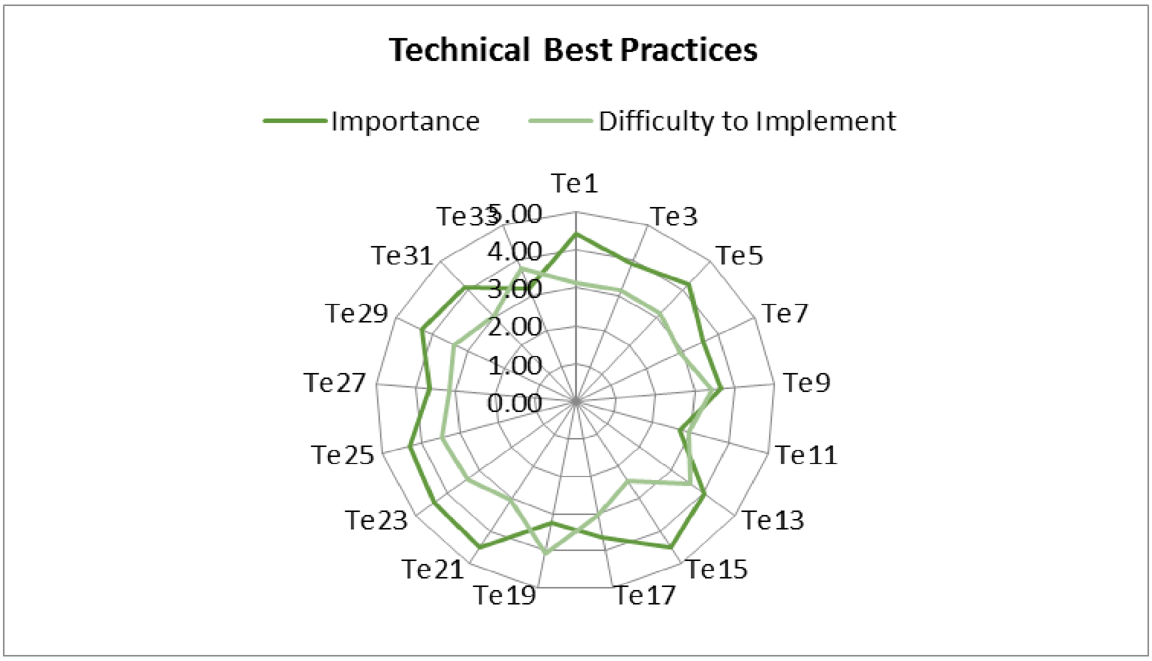


**Figure 5.16: Importance/difficulty of implementing technical best practices**

From the radar graph, the following conclusions can be made:

- *Monitoring fuel consumption* (Te15) and *Satellite tracking* (Te21) were both rated as extremely important to implement with a mean value of 4.52. Monitoring fuel consumption was seen as easy to implement with a difficulty of implementing score of only 2.48. Satellite tracking was seen as moderately difficult to implement with a mean value of 3.05.

- *Installing fleet management systems* (Te1) and *Load optimisation* (Te23) were both rated as the second-most important practices with a mean value of 4.43. Installing fleet management systems indicated to be very important, and rated as moderately difficult to implement with a mean value of 3.14. Load optimisation was seen as very important, but moderately difficult to implement with a mean value of 3.38.

- *Exchanging diesel vehicles for electric vehicles* (Te19) was rated as the most difficult practice to implement with a mean value of 4.05, and seen as somewhat important.

- *Solar roof to save energy* (Te33) was rated as the second-most difficult practice to implement with a mean value of 3.76.

Due to the high costs of implementing these practices companies might struggle to implement them.

#### *5.3.1.6 Internal best practices*

In this section, the importance to implement internal best practices and the difficulty of implementing each practice are discussed. Table 5.21 represents the code of each internal best practice (see Appendix E, page 309 to 314 for the variable frequency data of the internal best practices).

**Table 5.21: Codes representing internal best practices**

| |
|---|
| In1 = Fuel-saving tips for drivers |
| In3 = Reducing engine idling |
| In5 = Driver training |
| In7 = Bonus system to encourage drivers to drive safely and fuel-efficiently |
| In9 = Monitoring fuel consumption by installing fuel monitoring equipment |
| In11 = Creating safety manuals |
| In13 = Promoting environmental awareness among managers |
| In15 = Providing incentives for green behaviour practices |
| In17 = Publishing environmental efforts reports |
| In19 = Developing a formal environmental sustainability statement |

Table 5.22 indicates the mean values for the importance and difficulty to implement internal best practices.

**Table 5.22: Mean values for the importance and difficulty to implement internal best practices**

| | **In1** | **In3** | **In5** | **In7** | **In9** | **In11** | **In13** | **In15** | **In17** | **In19** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Importance** of implementing the practices | 4.48 | 4.43 | 4.86 | 4.43 | 4.24 | 4.19 | 4.57 | 3.90 | 4.00 | 4.14 |
| **Difficulty** to implement these practices | 2.33 | 2.29 | 2.71 | 4.43 | 2.71 | 2.33 | 2.43 | 2.95 | 2.67 | 2.76 |

The radar graph in Figure 5.17 below shows the importance and difficulty of implementing internal best practices.

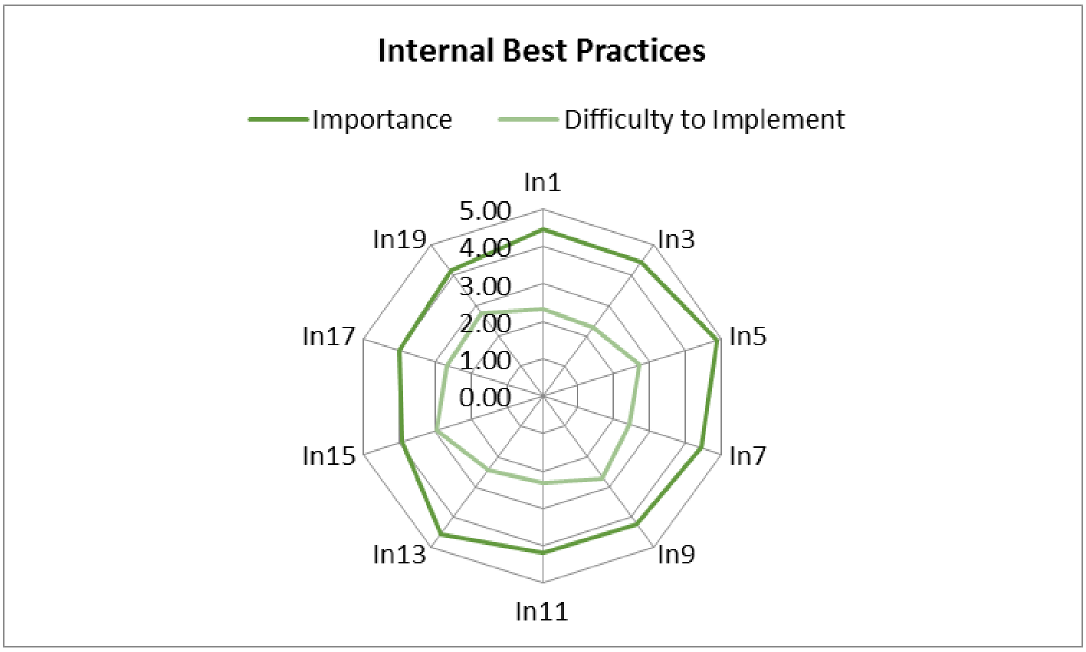


**Figure 5.17: Importance/difficulty of implementing internal best practices**

From the radar graph, the following conclusions can be made:

- *Driver training* (In5) was rated as extremely important to implement with a mean value of 4.86, and easy to implement with a mean value of 2.71.

- *Promoting environmental awareness among managers* (In13) was rated as extremely important with a mean value of 4.57, and easy to implement with a mean value of 2.43.

- *Bonus system to encourage drivers to drive safely and fuel-efficiently* (In7) was rated as the most difficult practice to implement with a mean value of 4.43, and very important to implement with a mean value of 4.43.

- *Providing incentives for green behaviour practices* (In15) was rated as the second-most difficult practice to implement with a mean value of 2.95. Although moderately difficult to implement, this practice was seen as very important.

## 5.4 PORTFOLIO MATRIX: FOUR TYPES OF OPPORTUNITIES

In this section, it is reported how the principles of a portfolio matrix were used to identify four types of opportunities which display the importance of green logistics practices in relation to the difficulty of implementing these practices, based on a mean value of 3 as threshold. This section will address the fourth secondary objective of the study, namely *to explore green logistics practices of logistics and transport companies located in Gauteng,* as well as the sixth secondary objective of the study, namely *to provide larger companies and SMEs with guidelines on how to implement green logistics practices.* Each portfolio matrix consists of four quadrants, as discussed below.

*Future transformers* (key long-term opportunities): This quadrant signifies those best practices with a high level of importance (mean values equal to or more than 3) and a high level of difficulty to implement (mean value equal to or more than 3). Resources and time are needed to implement these practices.

*Bulls eye* (key immediate) opportunities: This quadrant signifies those best practices with a high level of importance (mean values equal to or more than 3) and a low level of difficulty to implement (mean values less than 3). Only a few resources and little time are needed to implement the practices.

*Back burners* opportunities: This quadrant signifies those best practices with a low level of importance (mean value less than 3) and a high level of difficulty to implement (mean value equal to or more than 3). High impact on resources and time is needed to implement these practices.

*Can-do* opportunities: This quadrant signifies those best practices with a low level of importance (mean values less than 3) and a low level of difficulty to implement (mean values less than 3). Only a few resources and little time are needed to implement the practices. The portfolio matrix for each of the best practices is discussed in 5.4.1.

### 5.4.1 Strategic best practices

In this section, the importance of each strategic best practice is discussed in relation to the difficulty of implementing the practice. Figure 5.18 illustrates a portfolio matrix of the importance and difficulty to implement strategic best practices.

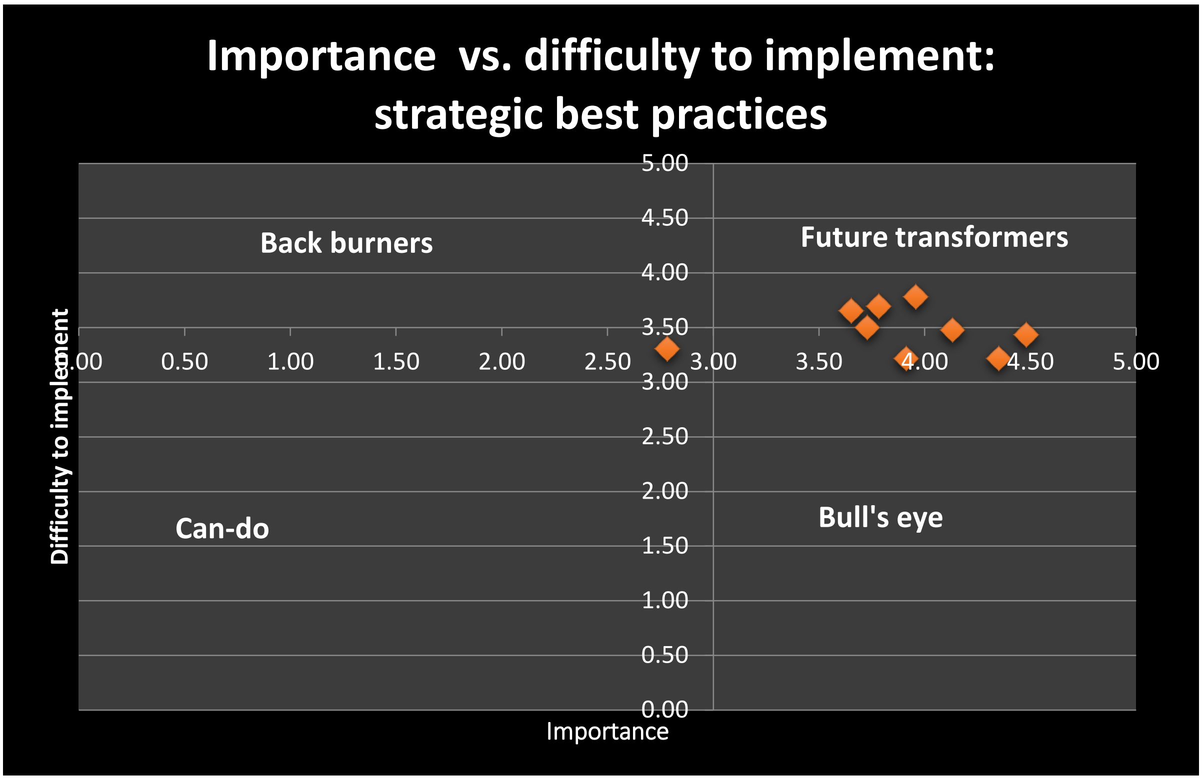


**Figure 5.18: Portfolio matrix – importance vs. difficulty to implement strategic best practices**

The portfolio matrix indicates that most of the strategic best practices are important to implement in terms of green logistics practices. Although rated mostly very important to implement most of these practices may be difficult for companies to implement. Most of these practices lie in the *future transformers* quadrant, which means that they have a high level of importance and are moderately to extremely difficult to implement. Resources and time are required to implement these practices, and the resources can be potentially cost-intensive to implement. Most of the practices can thus be categorised as *future transformers*.

The best practices in the *future transformers* quadrant with importance and difficulty imply values over 3, where **I = Importance mean values** and **D = Difficulty mean values**, namely:

- *Change of truck fleets* (I = 3.78; D = 3.70)
- *Creation of distribution centres* (I = 3.7; D = 3.50)
- *Sustainable carrier selection* (I = 4.13; D = 3.48)
- *Automatic warehousing system* (AWS) (I = 3.65; D = 3.65)
- *Facility design and construction* (I = 3.96; D = 3.48)
- *Carbon footprint assessment* (I = 4.35; D = 3.22)
- *Green customer criteria gathering* (I = 3.91; D = 3.22)
- *Introduction of tracking and tracing systems* (I = 4.48; D = 3.43)

Standardisation of truck sizes (I = 2.78; D = 3.30) is the only best practice that lies in the *back burners* quadrant, which implies that it is of little importance and moderately difficult to implement. See Table 5.12 for the mean values.

### 5.4.2 Tactical best practices

In this section, the importance of each tactical best practice is discussed in relation to the difficulty of implementing the practice. Figure 5.19 illustrates a portfolio matrix of the importance and difficulty to implement tactical best practices.

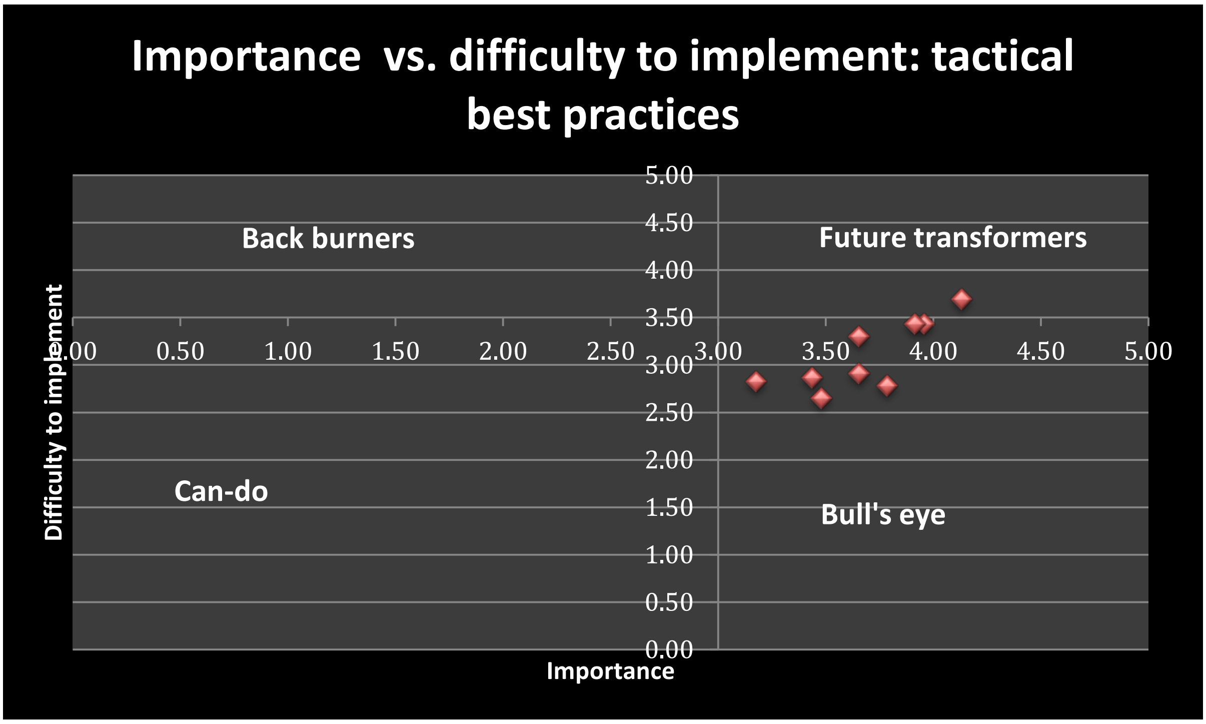


**Figure 5.19: Portfolio matrix – importance vs. difficulty to implement tactical best practices**

The portfolio matrix indicates that all of the tactical best practices are important to implement with regard to green logistics. Some of the tactical best practices lie within the *future transformers* quadrant, while most of them lie in the *bull's eye* quadrant.

The best practices that lie in the *future transformers* quadrant with importance and difficulty mean values over 3, where **I = Importance mean values** and **D = Difficulty mean values**, are:

- *Environmental certifications* (I = 4.13; D = 3.70)
- *Freight consolidation* (I = 3.96; D = 3.43)
- *Selection of different equipment*(I = 3.91; D = 3.43)
- *Use of different packaging technologies and material to reduce contamination* (I = 3.65; D = 3.30)

These practices were rated somewhat to extremely important to implement, and moderately to extremely difficult to implement with mean values higher than 3.

The five practices that are located in the *bull's eye* quadrant with importance mean values over 3 and difficulty mean values less than 3 are:

- *Palletisation of cargo* (I = 3.48; D = 2.65)
- *Modal choice* (I = 3.65; D = 2.91)
- *Reconditioning and reusing pallets and containers* (I = 3.78; D = 2.78)
- *Disposing of products* (I = 3.17; D = 2.83)
- *Pallet and container pooling systems* (I = 3.43; D = 2.87)

The practices that are located in the *bull's eye* quadrant are very important and not so difficult to implement. It is highly recommended that companies should strive to implement these practices located in the *bull's eye* quadrant because they are very important and relatively easy to implement. See Table 5.14 for the mean values.

### 5.4.3 Operational best practices

In this section, the importance of each operational best practice is discussed in relation to the difficulty of implementing the practice. Figure 5.20 illustrates a portfolio matrix of the importance and difficulty to implement operational best practices.

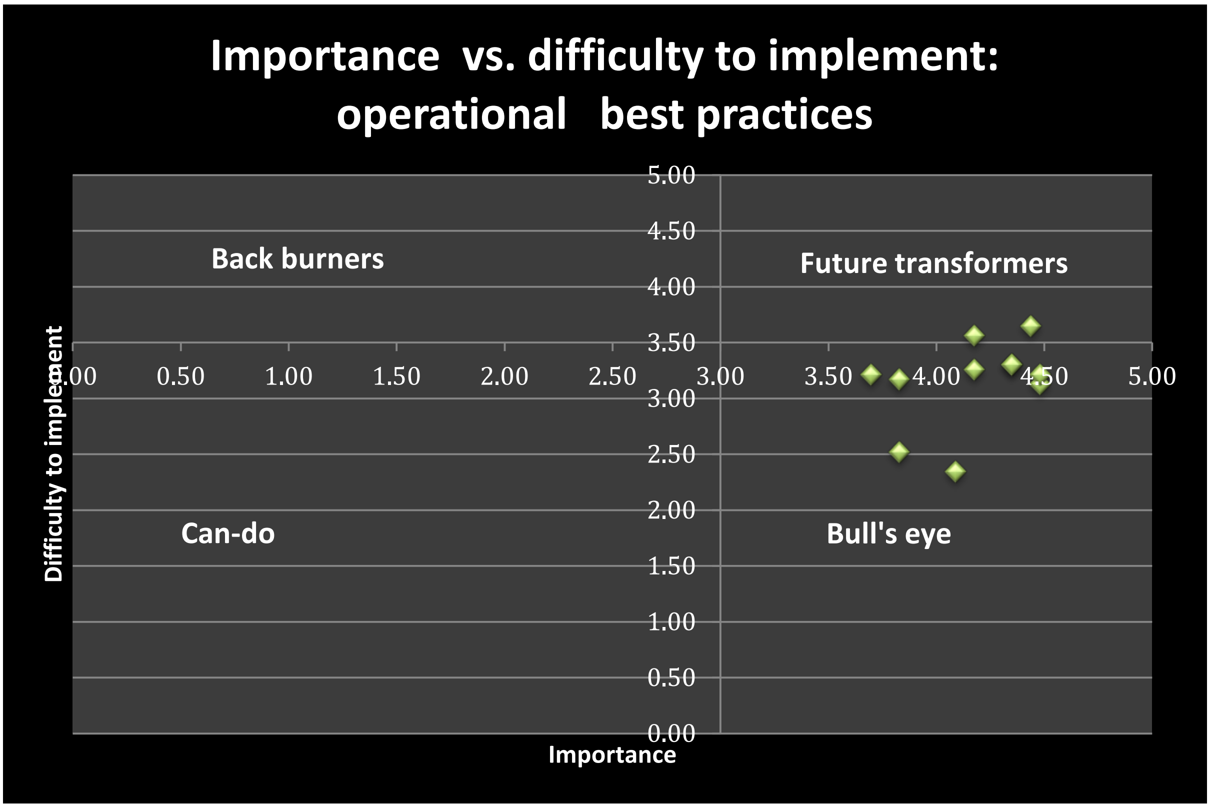


**Figure 5.20: Portfolio matrix – importance vs. difficulty to implement operational best practices**

The portfolio matrix indicates that all of the operational best practices are important to implement in terms of green logistics practices.

The best practices located in the *future transformers* quadrant with importance and difficulty mean values over 3, where **I = Importance mean values** and **D = Difficulty mean values**, are:

- *Fuel efficiency* (I = 4.48; D = 3.13)
- *Load optimisation* (I = 4.35; D = 3.30)
- *Energy efficiency* (I = 4.48; D = 3.22)
- *Process optimisation* (I = 4.43; D = 3.65)
- *Minimisation of inventories* (I = 4.17; D = 3.57)

- *On-site recycling, packaging recycling, use of ecological materials* (I = 3.70; D = 3.22)
- *Environmental footprint reports* (I = 3.83; D = 3.17)
- *Use of tracking and tracing systems to improve operations performance* (I = 4.35; D = 3.30)
- *Carbon footprint assessment* (I = 4.17; D = 3.26)

These practices located in the *future transformers* quadrant were rated somewhat to extremely important to implement, and moderately to extremely difficult to implement with mean values higher than 3.

The best practices located in the *bull's eye* quadrant with importance mean values over 3 and difficulty mean values less than 3 are:

- *Using clean vehicles* (I = 4.09; D = 2.35)
- *Clean material handling equipment* (I = 3.83; D = 2.52)

It is highly recommended that companies should aim to implement *using clean vehicles* and *clean material handling equipment*, as these were rated as very important and easy to implement with little resources and time needed for implementation. See Table 5.16 for the mean values.

### 5.4.4 Organisational best practices

In this section, the importance of each organisational best practice is discussed in relation to the difficulty of implementing the practice. Figure 5.21 illustrates a portfolio matrix of the importance and difficulty to implement organisational best practices.

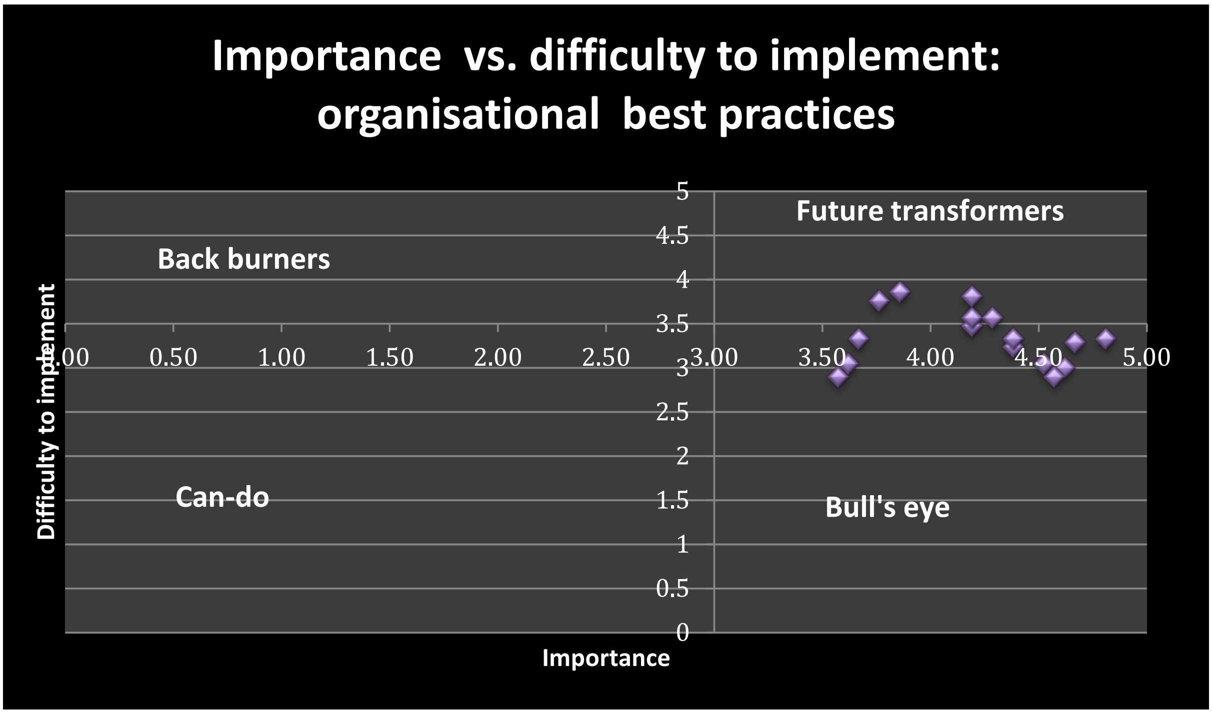


**Figure 5.21: Portfolio matrix – importance vs. difficulty to implement organisational best practices**

The portfolio matrix indicates that all of the organisational best practices are important to implement in terms of green logistics practices.

The best practices located in the *future transformers* quadrant with importance and difficulty mean values over 3, where **I = Importance mean values** and **D = Difficulty mean values**, are:

- *Optimal routing planning* (I = 4.67; D = 3.29)
- *Moving a national DC operation to a regional DC operation* (I = 3.76; D = 3.76)
- *Night-time deliveries* (I = 4.19; D = 3.48)
- *Optimising load fill* (I = 4.52; D = 3.05)
- *Reducing packaging* (I = 3.67; D = 3.33)
- *Developing relationships* (I = 4.62; D = 3.0)

- *More frequent deliveries* (I = 3.62; D = 3.05)
- *Distribution consolidation* (I = 4.19; D = 3.57)
- Multimodal services, e.g. *Road to rail then to road again* (I = 3.86; D = 3.86)
- *Development of a strategic environmental plan* (I = 4.38; D = 3.24)
- *Implementation of an environmental management system* (EMS) (I=4.29; D = 3.57)
- *Integrated management system* (IMS) (I = 4.19; D = 3.81)
- *Transport collaboration* (I = 4.38; D = 3.33)
- *Fuel management for transport operators, training of drivers, new technology* (I = 4.81; D = 3.33)

These practices located in the *future transformers* quadrant was rated somewhat to extremely important to implement, and moderately to extremely difficult to implement with mean values higher than 3. Resources and time are most likely needed to implement these practices.

The best practices located in the *bull's eye* quadrant with importance mean values over 3 and difficulty mean values less than 3 are:

- *Double stacking* (I = 3.57; D = 2.90)
- *Communication* (I = 4.57; D = 2.90)

It is highly recommended that companies should aim to implement *double stacking* and *communication*, as these were rated as very important and easy to implement with few resources and little time needed for implementation. See Table 5.18 for the mean values.

### 5.4.5 Technical best practices

In this section, the importance of each technical best practice is discussed in relation to the difficulty of implementing the practice. Figure 5.22 illustrates a portfolio matrix of the importance and difficulty to implement technical best practices.

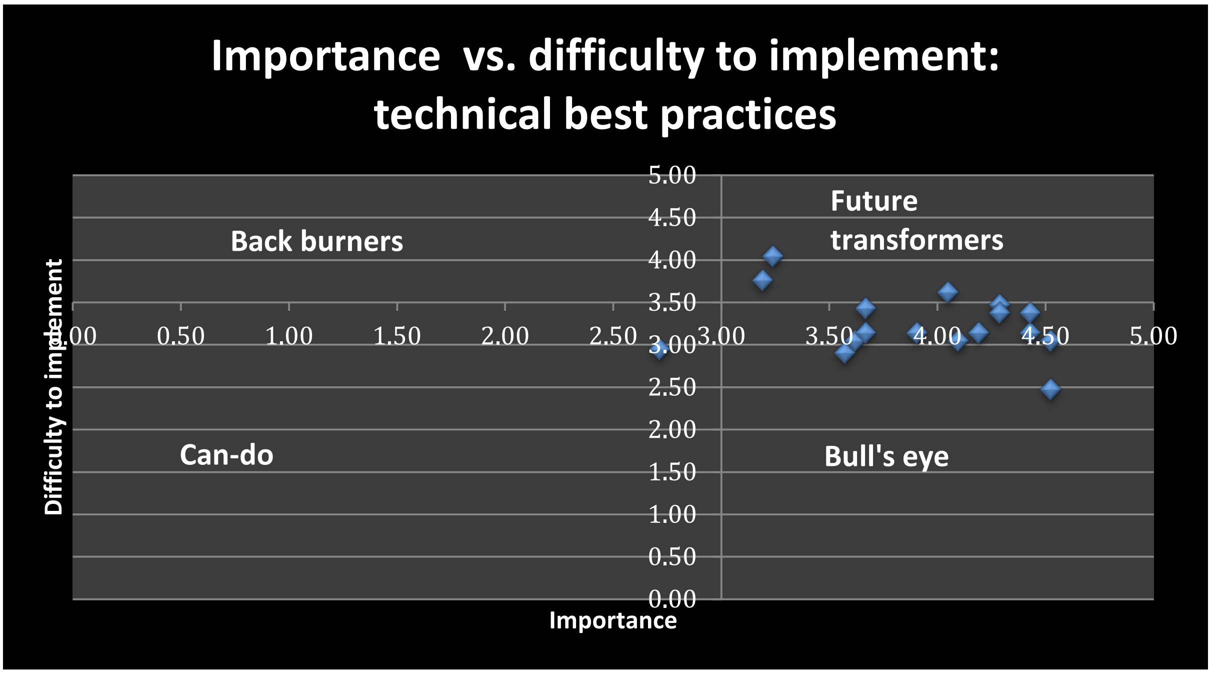


**Figure 5.22: Portfolio matrix – importance vs. difficulty to implement technical best practices**

The portfolio matrix indicates that all of the technical best practices are important to implement in terms of green logistics practices, except for one best practice that is located in the *Can-do* quadrant and which was rated as not so important with a mean value lower than 3.

The best practices located in the *future transformers* quadrant with importance and difficulty mean values over 3, where **I = Importance mean values** and **D = Difficulty mean values**, are:

- *Installing fleet management systems* (I = 4.4; D = 3.14)
- *Telematics* (I = 3.90; D = 3.14)
- *Using fuel-saving devices* (I = 4.19; D = 3.14)
- *Installing new washing facilities* (I = 3.67; D = 3.43)
- *Use of multimodal transport* (I = 4.05; D = 3.62)

- *Use of rainwater for vehicle cleaning* (I = 3.62; D = 3.05)
- *Exchanging diesel vehicles for electric vehicles* (I = 3.24; D = 4.05)
- *Satellite tracking* (I = 4.52; D = 3.05)
- *Load optimisation* (I = 4.43; D = 3.38)
- *Installing routing software* (I = 4.29; D = 3.48)
- *Electric forklift trucks instead of diesel* (I = 3.67; D = 3.14)
- *Installing software to measure, monitor and reduce fuel consumption* (I = 4.29; D = 3.38)
- *Load planning software* (I = 4.10 ; D =3.05)
- *Solar roof to save energy* (I = 3.19; D = 3.76)

These practices located in the *future transformers* quadrant was rated somewhat to extremely important to implement, and moderately to extremely difficult to implement with mean values higher than 3. Resources and time is most likely needed to implement these practices.

The best practices located in the *bull's eye* quadrant with importance mean values over 3 and difficulty mean values less than 3 are:

- *Euro IV lubricating oils* (I = 3.57; D = 2.90)
- *Monitoring fuel consumption* (I = 4.52; D = 2.48)

It is highly recommended that companies should aim to implement *Euro IV lubricating oils* and *monitoring fuel consumption* as these were rated as very important and easy to implement with few resources and little time needed for implementation.

The best practice located in the *can-do* quadrant with an importance and difficulty mean value less than 3 is:

- *Using double-deck trailers to replace single-deck trailers* (I = 2.71; D = 2.95)

This practice was rated not so important to implement with a mean value less than 3, and as not so difficult to implement with a mean value of 2.95. Companies should try to avoid implementing practices which are less important, and should rather focus on the important practices to implement. See Table 5.20 for the mean values.

### 5.4.6 Internal best practices

In this section, the importance of each internal best practice is discussed in relation to the difficulty of implementing the practice. Figure 5.23 illustrates a portfolio matrix of the importance and difficulty to implement internal best practices.

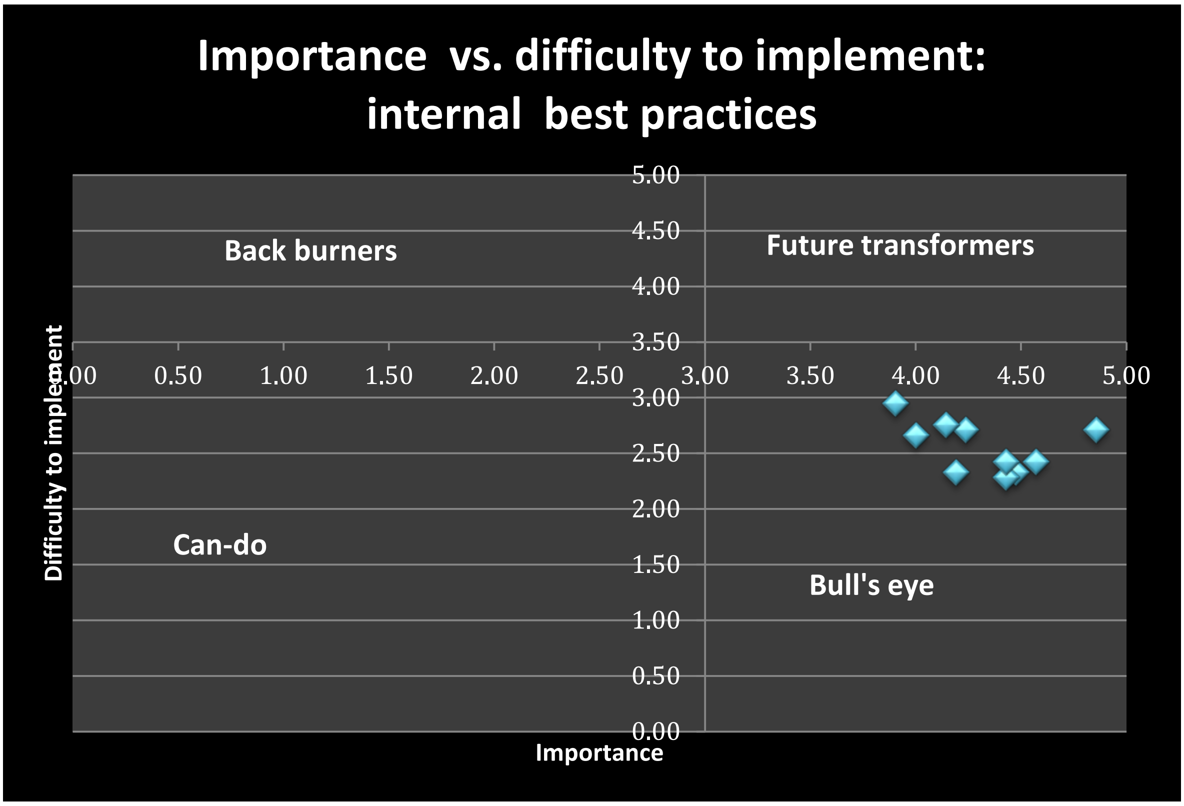


**Figure 5.23: Portfolio matrix – importance vs. difficulty to implement internal best practices**

The portfolio matrix indicates that all of the internal best practices are important to implement in terms of green logistics practices, and all lie in the *bull's eye* quadrant.

The following best practices located in the *bull's eye* quadrant with importance mean values over 3 and difficulty mean values less than 3, where **I = Importance mean values** and **D = Difficulty mean values**, are:

- *Fuel-saving tips for drivers* (I = 4.48; D = 2.33)
- *Reducing engine idling* (I = 4.43; D = 2.29)
- *Driver training* (I = 4.86; D = 2.71)

- *Bonus system to encourage drivers to drive safely and fuel-efficiently* (I = 4.43; D = 4.43)
- *Monitoring fuel consumption by installing fuel monitoring equipment* (I = 4.24; D = 2.71)
- *Creating safety manuals* (I = 4.19; D = 2.33)
- *Promoting environmental awareness among managers* (I = 4.57; D = 2.43)
- *Providing incentives for green behaviour practices* (I = 3.90 D = 2.95)
- *Publishing environmental efforts reports* (I = 4.00; D = 2.67)
- *Developing a formal environmental sustainability statement* (I = 4.14; D = 2.67)

It is highly recommended that companies should strive to implement these practices as they are very important and easy to implement, with little time and resources required. See Table 5.22 for the mean values.

Table 5.23 presents a summary of the results of the best practices which are located within each of the four quadrants. This table was used to compile the conceptual framework in green logistics for companies located in South Africa, and to make suggestions for the implementation of these practices for the large and small logistics and transport companies in South Africa.

**Table 5.23: Best practices that lie within each of the four quadrants**

| **Best practices in the *future transformers* quadrant – high level of importance, moderate to high level of difficulty** |
|---|
| • ***Changing truck fleets***<br>• ***Creation of distribution centres***<br>• ***Sustainable carrier selection***<br>• ***Automatic warehousing system* (AWS)**<br>• ***Facility design and construction***<br>• ***Carbon footprint assessment***<br>• ***Green customer criteria gathering***<br>• ***Introduction of tracking and tracing systems***<br>• ***Environmental certifications***<br>• ***Freight consolidation***<br>• ***Selection of different equipment***<br>• ***Using different packaging technologies and material to reduce contamination***<br>• ***Fuel efficiency***<br>• ***Load optimisation***<br>• ***Energy efficiency*** |

- ***Process optimisation***
- ***Minimisation of inventories***
- ***On-site recycling, packaging recycling, use of ecological materials***
- ***Environmental footprint reports***
- ***Using tracking and tracing systems to improve operations performance***
- ***Carbon footprint assessment***
- ***Optimal routing planning***
- ***Moving a national DC operation to a regional DC operation***
- ***Night-time deliveries***
- ***Optimising load fill***
- ***Reducing packaging***
- ***Developing relationships***
- ***More frequent deliveries***
- ***Distribution consolidation***
- ***Multimodal services, e.g. Road to rail then to road again***
- ***Development of a strategic environmental plan***
- ***Implementation of an environmental management system* (EMS)**
- ***Integrated management system* (IMS)**
- ***Transport collaboration***
- ***Fuel management for transport operators, training of drivers, new technology***
- ***Installing fleet management systems***
- ***Telematics***
- ***Using fuel saving devices***
- ***Installing new washing facilities***
- ***Use of multimodal transport***
- ***Use of rainwater for vehicle cleaning***
- ***Exchanging diesel vehicles for electric vehicles***
- ***Satellite tracking***
- ***Load optimisation***
- ***Installing routing software***
- ***Electric forklifts instead of diesel***
- ***Installing software to measure, monitor and reduce fuel consumption***
- ***Load planning software***
- ***Solar roof to save energy***

**Best practices in the *bull's eye* quadrant – high level of importance, low level of difficulty**

- ***Palletisation of cargo***
- ***Modal choice***
- ***Reconditioning and reusing pallets and containers***
- ***Disposing of products***
- ***Pallet and container pooling systems***
- ***Using clean vehicles***
- ***Clean material handling equipment***
- ***Euro IV lubricating oils***
- ***Monitoring fuel consumption***
- ***Fuel-saving tips for drivers***
- ***Reducing engine idling***
- ***Driver training***
- ***Bonus system to encourage drivers to drive safely and fuel-efficiently***
- ***Monitoring fuel consumption by installing fuel monitoring equipment***

| |
|---|
| • *Creating safety manuals*<br>• *Promoting environmental awareness among managers*<br>• *Providing incentives for green behaviour practices*<br>• *Publishing environmental efforts reports*<br>• *Developing a formal environmental sustainability statement*<br>• *Double stacking*<br>• *Communication* |
| **Best practices in the *back burners* quadrant – low level of importance, high level of difficulty** |
| • *Standardisation of truck sizes* |
| **Best practices in the *can-do* quadrant – low level of importance, low level of difficulty** |
| • *Using double-deck trailers to replace single-deck trailers* |

## 5.5 INFERENTIAL STATISTICAL INTERPRETATION

In this section, the focus is on the perceptions of the two employee groups (< 200, 200 and above) regarding the importance of implementing strategic, tactical, operational, organisational and internal best practices. The employee groups were divided into two groups. Group 1 comprised SMEs with fewer than 200 employees. Group 2 comprised large logistics companies with more than 200 employees. The aim was to test whether or not there was a statistically significant difference between small and large companies' perceptions of the practices. A Mann–Whitney U nonparametric test was used to test the statistical significance of each of the best practices.

Nonparametric statistics are suitable when the variable being analysed does not conform to any known or continuous distribution (Zikmund *et al.*, 2010). The Mann–Whitney U test can be used when two independent groups need to be compared based on a single variable.

It is useful to apply this test when the sample from the population is small or if the data type is ordinal. The reason for this test is that, when all the values of the study variable are ranked, ignoring to which group the values belong, the ranks should be evenly spread across the two groups if the two populations have equal medians. For the inferential statistical data of section 5.5, refer to Appendix F page 315 to 322.

### 5.5.1 Hypothesis for Mann–Whitney U tests (best practices in green logistics management)

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their importance rating regarding green logistic practices.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their importance rating regarding green logistic practices.

Table 5.24 shows the statistical significance difference at the 5% level of significance (exact significance used), between the two employee groups (< 200, 200 and above) with regard to their importance rating regarding green logistic practices.

The results indicated that there is a statistically significant difference at the 5% level of significance between the employee groups with regard to *palletisation of cargo* ($p$ = 0.036) and *environmental certifications* (p = 0.044). Furthermore, the mean ranks indicate that the employee group 200 and more tended to consider these two practices as more important (mean ranks of 13.74 and 13.71 respectively) than the employee group (fewer than 200 employees) with mean ranks of 7.08 and 7.17 respectively. See Appendix F page 319 for the tactical inferential statistics.

**Table 5.24: Statistical differences in tactical best practices between the two employee groups**

| | Ta1 | Ta3 | Ta5 | Ta7 | Ta9 | Ta11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 21.500 | 45.000 | 51.000 | 49.000 | 44.500 | 38.000 |
| Asymp. sig. (2-tailed) | .031 | .645 | 1.000 | .882 | .626 | .337 |
| Exact sig. [2*(1-tailed sig.)] | **.036[b]** | .708[b] | 1.000[b] | .919[b] | .658[b] | .392[b] |

| | Ta13 | Ta15 | Ta17 |
|---|---|---|---|
| Mann–Whitney U | 22.000 | 33.000 | 51.000 |
| Asymp. sig. (2-tailed) | .028 | .186 | 1.000 |
| Exact sig. [2*(1-tailed sig.)] | **.044[b]** | .227[b] | 1.000[b] |

None of the strategic (St1–St17) best practices differ statistically significant between the employee groups as depicted in Table 5.25. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the following practices as slightly more important than the large employee group: *standardisation of truck sizes (St3), creation of distribution centres (St5), sustainable carrier selection (St7)* and *green customer criteria collection (St15)*. See Appendix F page 318 to 319 for the strategic inferential statistics.

**Table 5.25: Statistical differences in strategic best practices between the two employee groups**

| | St1 | St3 | St5 | St7 | St9 | St11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 43.000 | 40.000 | 34.500 | 30.500 | 45.500 | 40.000 |
| Asymp. sig. (2-tailed) | .557 | .425 | .302 | .118 | .690 | .407 |
| Exact sig. [2*(1-tailed sig.)] | .609[b] | .473[b] | .329[b] | .155[b] | .708[b] | .473[b] |

| | St13 | St15 | St17 |
|---|---|---|---|
| Mann–Whitney U | 35.000 | 49.000 | 44.500 |
| Asymp. sig. (2-tailed) | .211 | .883 | .606 |
| Exact sig. [2*(1-tailed sig.)] | .286[b] | .919[b] | .658[b] |

None of the operational (Op1–Op21) best practices differ statistically significant between the employee groups as displayed in Table 5.26. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the following practices as slightly more important than the large employee group: *using clean vehicles (Op1), fuel efficiency (Op3), clean material handling equipment (Op7)* and *energy efficiency (Op9)*. See Appendix F page 319 to 320 for the operational inferential statistics.

**Table 5.26: Statistical differences in operational best practices between the two employee groups**

| | Op1 | Op3 | Op5 | Op7 | Op9 | Op11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 37.500 | 46.000 | 45.000 | 25.500 | 43.000 | 47.000 |
| Asymp. sig. (2-tailed) | .284 | .628 | .634 | .055 | .521 | .754 |
| Exact sig. [2*(1-tailed sig.)] | .354[b] | .759[b] | .708[b] | .074[b] | .609[b] | .812[b] |

| | Op13 | Op15 | Op17 | Op19 | Op21 |
|---|---|---|---|---|---|
| Mann–Whitney U | 32.500 | 50.500 | 39.000 | 44.000 | 42.000 |
| Asymp. sig. (2-tailed) | .160 | .971 | .379 | .573 | .500 |
| Exact sig. [2*(1-tailed sig.)] | .201[b] | .973[b] | .431[b] | .658[b] | .562[b] |

None of the organisational (Or1–Or31) best practices differ statistically significant between the employee groups as displayed in Table 5.27. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the following practices as slightly more important than the large employee group: *optimal routing planning (Or1), double stacking (Or3), optimising load fill (Or9), reducing packaging (Or11), developing* *relationships (Or13), more frequent deliveries (Or15) and multimodal services (Or19)*. See Appendix F page 320 to 321 for the organisational inferential statistics.

**Table 5.27: Statistical differences in organisational best practices between the two employee groups**

| | Or1 | Or3 | Or5 | Or7 | Or9 | Or11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 40.000 | 40.000 | 29.500 | 44.000 | 30.500 | 37.500 |
| Asymp. sig. (2-tailed) | .622 | .684 | .205 | .931 | .190 | .537 |
| Exact sig. [2*(1-tailed sig.)] | .733[b] | .733[b] | .235[b] | .970[b] | .267[b] | .569[b] |

| | Or13 | Or15 | Or17 | Or19 | Or21 | Or23 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 44.000 | 33.000 | 37.000 | 22.000 | 40.000 | 30.000 |
| Asymp. Sig. (2-tailed) | .925 | .330 | .502 | .052 | .666 | .203 |
| Exact sig. [2*(1-tailed sig.)] | .970[b] | .381[b] | .569[b] | .080[b] | .733[b] | .267[b] |

| | Or25 | Or27 | Or29 | Or31 |
|---|---|---|---|---|
| Mann–Whitney U | 43.000 | 35.000 | 34.000 | 43.500 |
| Asymp. sig. (2-tailed) | .868 | .361 | .344 | .864 |
| Exact sig. [2*(1-tailed sig.)] | .910[b] | .470[b] | .424[b] | .910[b] |

None of the technical (Te1–Te33) best practices differ statistically significant between the employee groups as depicted in Table 5.28. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the following practices as slightly more important than the large employee group: *installing new washing facilities (Te9), using double-deck trailers to replace single-deck trailers (Te11), using multi-modal transport (Te13), load optimisation (Te23)* and *installing software to monitor and reduce fuel consumption (Te29)*. See Appendix F page 321 to 322 for the technical inferential statistics.

**Table 5.28: Statistical differences in technical best practices between the two employee groups**

| | Te1 | Te3 | Te5 | Te7 | Te9 | Te11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 32.500 | 23.500 | 43.000 | 41.000 | 33.000 | 44.000 |
| Asymp. sig. (2-tailed) | .272 | .077 | .868 | .746 | .327 | .937 |
| Exact sig. [2*(1-tailed sig.)] | .340[b] | .095[b] | .910[b] | .791[b] | .381[b] | .970[b] |

| | Te13 | Te15 | Te17 | Te19 | Te21 | Te23 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 43.500 | 44.500 | 23.000 | 32.500 | 37.500 | 31.500 |
| Asymp. Sig. (2-tailed) | .901 | .963 | .076 | .316 | .503 | .237 |
| Exact sig. [2*(1-tailed sig.)] | .910[b] | .970[b] | .095[b] | .340[b] | .569[b] | .302[b] |

| | Te25 | Te27 | Te29 | Te31 | Te33 |
|---|---|---|---|---|---|
| Mann–Whitney U | 39.500 | 44.500 | 41.000 | 33.000 | 38.000 |
| Asymp. sig. (2-tailed) | .633 | .968 | .728 | .290 | .571 |
| Exact sig. [2*(1-tailed sig.)] | .677[b] | .970[b] | .791[b] | .381[b] | .622[b] |

None of the internal best practices (In 1–In19) differ statistically significant between the employee groups. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the following practices as slightly more important than the large employee group:

- *fuel-saving tips for drivers (In1), reducing engine idling (In3), driver training (In5);*
- *bonus system to encourage drivers to drive safely and fuel-efficiently (In7);*
- *monitoring fuel consumption by installing fuel monitoring equipment (In9);*
- *creating safety manuals (In11);*
- *promoting environmental awareness among managers (In13);* and
- *providing incentives for green behaviour practices (In15)*.

Table 5.29 below shows statistical differences in internal best practices between the two employee groups. See Appendix F page 322 for the internal inferential statistics.

**Table 5.29: Statistical differences in internal best practices between the two employee groups**

| | In1 | In3 | In5 | In7 | In9 | In11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 37.000 | 36.000 | 36.000 | 30.000 | 37.500 | 33.000 |
| Asymp. sig. (2-tailed) | .480 | .430 | .248 | .178 | .518 | .307 |
| Exact sig. [2*(1-tailed sig.)] | .569[b] | .519[b] | .519[b] | .267[b] | .569[b] | .381[b] |

| | In13 | In15 | In17 | In19 |
|---|---|---|---|---|
| Mann–Whitney U | 31.000 | 40.000 | 35.500 | 35.500 |
| Asymp. sig. (2-tailed) | .201 | .677 | .436 | .414 |
| Exact sig. [2*(1-tailed sig.)] | .302[b] | .733[b] | .470[b] | .470[b] |

### 5.5.2 Hypothesis for Mann–Whitney U tests (drivers of green logistics)

In this section, the focus is on the perceptions of the two employee groups (< 200, 200 and above) regarding the importance of the drivers of green logistics. The employee groups were divided into two groups. Group 1 comprised SMEs with fewer than 200 employees. Group 2 comprised large logistics companies with more than 200 employees. The aim was to test whether or not there was a statistically significant difference between small and large companies' perceptions of the importance of the drivers of green logistics. A Mann-Whitney U nonparametric test was used to test the statistical significance of each driver.

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the drivers of green logistics.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the drivers of green logistics.

**Table 5.30: Statistical differences of the importance of green logistics drivers between the two employee groups**

| | d1 | d2 | d3 | d4 | d5 | d6 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 120.000 | 129.500 | 117.500 | 126.000 | 83.000 | 135.500 |
| Asymp. sig. (2-tailed) | .371 | .597 | .348 | .513 | **.021** | .752 |
| Exact sig. [2*(1-tailed sig.)] | .436[b] | .631[b] | .379[b] | .562[b] | .041[b] | .779[b] |

| | d7 | d8 | d9 | d10 | d11 | d12 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 141.000 | 134.000 | 140.000 | 138.000 | 133.500 | 100.000 |
| Asymp. sig. (2-tailed) | .910 | .715 | .882 | .824 | .683 | .215 |
| Exact sig. [2*(1-tailed sig.)] | .934[b] | .753[b] | .908[b] | .856[b] | .728[b] | .268[b] |

| | d13 | d14 | d15 | d16 | d17 | d18 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 75.500 | 128.500 | 130.000 | 119.500 | 105.500 | 141.000 |
| Asymp. sig. (2-tailed) | **.013** | .587 | .595 | .628 | .144 | .910 |
| Exact sig. [2*(1-tailed sig.)] | .020[b] | .608[b] | .655[b] | .662[b] | .199[b] | .934[b] |

| | d19 |
|---|---|
| Mann–Whitney U | 126.000 |
| Asymp. sig. (2-tailed) | .512 |
| Exact sig. [2*(1-tailed sig.)] | .562[b] |

The results indicate that there is a statistically significant difference, at the 10% level of significance between the employee groups with regard to *decreasing fuel bills (D5)* ($p$ = 0.021) and *decreasing risk (D13)* (p = 0.013). Furthermore, the mean ranks indicate that the employee group with 200 and fewer participants tended to consider these two practices as more important (mean ranks of 23.58 and 24.21 respectively) than the employee group with more than 200 employees with mean ranks of 15.96 and 15.65 respectively. See Appendix F page 315 to 316 for the inferential statistics of the drivers of green logistics.

### 5.5.3 Hypothesis for Mann–Whitney U tests (benefits of green logistics)

In this section, the focus is on the perceptions of the two employee groups (< 200, 200 and above) regarding the benefits of green logistics. The employee groups were divided into two groups. Group 1 comprised SMEs with fewer than 200 employees. Group 2 comprised large logistics companies with more than 200 employees. The aim was to test whether or not there is a statistically significant difference between small and large companies' perceptions of the benefits of green logistics. A Mann-Whitney nonparametric test was used to test the statistical significance of each benefit.

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the benefits of green logistics.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the benefits of green logistics.

**Table 5.31: Statistical differences of the importance of green logistics benefits between the two employee groups**

| | b1 | b2 | b3 | b4 | b5 |
|---|---|---|---|---|---|
| Mann–Whitney U | 109.500 | 96.000 | 103.500 | 97.000 | 100.000 |
| Asymp. sig. (2-tailed) | .812 | .423 | .621 | .433 | .515 |
| Exact sig. [2*(1-tailed sig.)] | .832[b] | .475[b] | .658[b] | .499[b] | .576[b] |

| | b6 | b7 | b8 | b9 | b10 | b11 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 78.000 | 100.000 | 86.500 | 71.500 | 88.000 | 105.000 |
| Asymp. sig. (2-tailed) | **.097** | .508 | .220 | .152 | .258 | .656 |
| Exact sig. [2*(1-tailed sig.)] | .155[b] | .576[b] | .269[b] | .183[b] | .305[b] | .714[b] |

| | b12 | b13 | b14 | b15 | b16 | b17 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 88.500 | 60.000 | 93.500 | 73.500 | 81.000 | 81.000 |
| Asymp. sig. (2-tailed) | .274 | **.030** | .459 | .114 | .214 | .203 |
| Exact sig. [2*(1-tailed sig.)] | .305[b] | .043[b] | .509[b] | .140[b] | .251[b] | .251[b] |

| | b18 | b19 | b20 | b21 |
|---|---|---|---|---|
| Mann–Whitney U | 95.500 | 79.000 | 83.500 | 81.000 |
| Asymp. sig. (2-tailed) | .522 | .141 | .231 | .208 |
| Exact sig. [2*(1-tailed sig.)] | .562[b] | .219[b] | .287[b] | .251[b] |

The results indicate that there is a statistically significant difference at the 10% level of significance between the employee groups with regard to *improving profits (B6)* ($p$ = 0.097) and *winning new customers (B13)* ($p$ = 0.030). Furthermore, the mean ranks indicate that the employee group (200 and fewer) tended to consider these two practices as more important (mean ranks of 20.70 and 21.50 respectively) than the employee group (more than 200 employees) with mean ranks of 15.39 and 14.23 respectively. See Appendix F page 316 to 317 for the inferential statistics of the benefits of green logistics.

### 5.5.4 Hypothesis for Mann –Whitney U tests (Barriers of green logistics)

In this section the focus will be on the perceptions of the two employee groups (< 200, 200 and above) regarding the barriers of green logistics. The employee groups are divided into two groups. Group 1 is SME's with less than 200 employees. Group 2 are larger logistics companies with more than 200 employees. The aim is to test whether or not there is a statistical significant difference between smaller and larger companies' perceptions of the barriers of green logistics. A Mann-Whitney U nonparametric test was used to test the statistical significance of each barrier.

H0: There is no difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the barriers of green logistics.

H1: There is a difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the barriers of green logistics.

**Table 5.32: Statistical differences of the importance of green logistics barriers between the two employee groups**

| | ba1 | ba2 |
|---|---|---|
| Mann–Whitney U | 74.000 | 83.500 |
| Asymp. sig. (2-tailed) | .601 | .979 |
| Exact sig. [2*(1-tailed sig.)] | .649[b] | .981[b] |

| | ba3 | ba4 | ba5 | ba6 | ba7 | ba8 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 65.500 | 73.500 | 72.000 | 73.000 | 61.500 | 59.000 |
| Asymp. sig. (2-tailed) | .440 | .716 | .666 | .706 | .317 | .258 |
| Exact sig. [2*(1-tailed sig.)] | .469[b] | .746[b] | .709[b] | .746[b] | .354[b] | .304[b] |

| | ba15 | ba16 | ba17 | ba18 | ba19 | ba20 |
|---|---|---|---|---|---|---|
| Mann–Whitney U | 70.000 | 71.000 | 72.000 | 78.500 | 75.000 | 79.000 |
| Asymp. sig. (2-tailed) | 1.000 | .626 | .673 | .933 | .776 | .957 |
| Exact sig. [2*(1-tailed sig.)] | 1.000[b] | .672[b] | .709[b] | .940[b] | .823[b] | .980[b] |

None of the barriers differ statistically significant between the employee groups. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the following practices as slightly more important than the large employee groups:

- *Lack of acceptance of advancement in new technology (Ba2);*
- *Poor organisational culture in GSCM (Ba3);*
- *Uncertainty and competition in market (Ba5);*
- *Lack of flexibility of suppliers to change towards GSCM (Ba10);*
- *Lack of green architects, consultants, green developers, contractors in the region (Ba13);*
- *Lack of training in GSCM (Ba14);*
- *Lack of sustainability certification like ISO14001 (Ba17); and*

- *Lack of professional treatment and long term contracts for adopting GSCM from government (Ba18).* See Appendix F page 317 to 318 for the inferential statistics of the barriers of green logistics.

The next section reflects cross-tabulations which were used to explain the profile of the respondents with regard to their company turnover vs. number of employee, company turnover vs. warehouses in square meters and company turnover vs. number of vehicles.

## 5.6 CROSS-TABULATIONS

This section provides a discussion of cross-tabulations which were used to determine whether there is a relationship between two variables, namely company turnover vs. number of employees, company turnover vs. warehouses in square meters and company turnover vs. number of vehicles.

**Table 5.33: Cross-tabulation for company turnover vs. number of employees**

| | | Company turnover | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Less than R10 million | R10 million - R100 million | R101 - R150 million | R151 - R500 million | R500+ million | Unsure | Total |
| Number of employees | Fewer than 100 | 5.56 | 11.11 | 5.56 | 2.78 | 0.00 | 0.00 | 25.00 |
| | 100-200 | 0.00 | 5.56 | 0.00 | 2.78 | 0.00 | 0.00 | 8.33 |
| | 201-1000 | 0.00 | 0.00 | 0.00 | 2.78 | 8.33 | 0.00 | 11.11 |
| | 1 001-10 000 | 0.00 | 0.00 | 0.00 | 2.78 | 19.44 | 0.00 | 22.22 |
| | 10 000+ | 0.00 | 0.00 | 0.00 | 0.00 | 30.56 | 2.78 | 33.33 |
| Total | | 5.56 | 16.67 | 5.56 | 11.11 | 58.33 | 2.78 | 100.00 |

From Table 5.33 the following assumptions can be made:

- 5.56% of companies who reported a turnover of less than R10 million employed fewer than 100 employees;

- 16.67% of companies who had a turnover of between R10 million and R100 million, employed fewer than 100 and between 100 and 200 employees;
- 5.56% of companies who reported a turnover of between R101 and R150 million, employed fewer than 100 employees;
- 11.11% of the companies had a turnover of between R151 and R500 million, 5.56% employed fewer than 200 employees, and 5.56% employed more than 200 employees; and
- 58.33% of companies who had a turnover of more than R500 million, employed more than 10 000 employees (30.56%).

Table 5.33 illustrates that there is a positive relationship between company turnover and the number of employees. The higher a company's turnover per annum, the higher the number of employees employed by the logistics and transport companies.

**Table 5.34: Cross-tabulation for company turnover vs. warehouses m²**

| | | Company turnover | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Less than R10 million | R10 million–R100 million | R101 million–R150 million | R151 million–R500 million | R500+ million | Unsure | Total |
| Warehouses in $m^2$ | Less than 10 000 $m^2$ | 5.56 | 8.33 | 2.78 | 0.00 | 2.78 | 0.00 | 19.44 |
| | 10 000–20 000 $m^2$ | 0.00 | 2.78 | 2.78 | 0.00 | 8.33 | 0.00 | 13.89 |
| | 20 001–30 000 $m^2$ | 0.00 | 0.00 | 0.00 | 2.78 | 0.00 | 0.00 | 2.78 |
| | 30 001–40 000 $m^2$ | 0.00 | 2.78 | 0.00 | 2.78 | 2.78 | 0.00 | 8.33 |
| | 40 000+ $m^2$ | 0.00 | 0.00 | 0.00 | 2.78 | 27.78 | 0.00 | 30.56 |
| | Unsure | 0.00 | 2.78 | 0.00 | 2.78 | 16.67 | 2.78 | 25.00 |
| Total | | 5.56 | 16.67 | 5.56 | 11.11 | 58.33 | 2.78 | 100.00 |

- 5.56% of companies who had a turnover of less than R10 million, owned warehouses of less than 100 000 $m^2$;

- 16.67% of companies who had a turnover of between R10 million and R100 million, owned warehouses of less than 10 000 $m^2$ (8.33%) and between 10 000 $m^2$ and 40 000 $m^2$ (5.56%);
- 5.56% of companies who had a turnover of between R101 million and R150 million, owned warehouses of less than 10 000$m^2$ and between 10 000 and 20 000 $m^2$;
- 11.11% of companies who had a turnover of between R151million and R500 million, owned warehouses of more than 40 000 $m^2$ (2.78%) and between 20 001 $m^2$ and 40 000 $m^2$ (5.56%);
- 58.33% of companies who had a turnover of more than R500 million, owned warehouses of more than 40 000 $m^2$ (27.78%); and
- 2.78% were unsure of the sizes of the warehouses owned by their company in square meters.

Table 5.34 illustrates that there is a positive relationship between company turnover and warehouses in square meters. The higher a logistics and transport company's annual turnover, the bigger the warehouses in square meters that such a company owns.

**Table 5.35: Cross-tabulation for company turnover vs. number of vehicles**

| | | Company turnover | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Less than R10 million | R10 million–R100 million | R101 million–R150 million | R151 million–R500 million | R500+ million | Unsure | Total |
| Number of vehicles | Fewer than 10 | 2.78 | 5.56 | 0.00 | 2.78 | 0.00 | 0.00 | 11.11 |
| | 10–100 | 2.78 | 11.11 | 5.56 | 0.00 | 2.78 | 0.00 | 22.22 |
| | 101–1000 | 0.00 | 0.00 | 0.00 | 5.56 | 22.22 | 0.00 | 27.78 |
| | 1 001–10 000 | 0.00 | 0.00 | 0.00 | 2.78 | 19.44 | 0.00 | 22.22 |
| | 10 000+ | 0.00 | 0.00 | 0.00 | 0.00 | 8.33 | 2.78 | 11.11 |
| | Unsure | 0.00 | 0.00 | 0.00 | 0.00 | 5.56 | 0.00 | 5.56 |
| Total | | 5.56 | 16.67 | 5.56 | 11.11 | 58.33 | 2.78 | 100.00 |

- 5.56% of companies who had a turnover of less than R10 million, owned fewer than 100 vehicles;
- 16.67% of companies who had a turnover of between R10 million and R100 million, owned fewer than a 100 vehicles;
- 5.56% of companies who had a turnover of between R101 and R150 million, owned fewer than a 100 vehicles;
- 11.11% of companies who had a turnover of between R151-R500 million, owned fewer than 10 000 vehicles;
- 58.33% of companies who had a turnover of more than R500 million, owned more than 10 000 vehicles (8.33%); and
- 2.78% were unsure of the number of vehicles (trucks) they owned.

Table 5.35 illustrates that, in the current study there was a positive relationship between company turnover and number of vehicles. The higher a logistics and transport company's annual turnover, the higher the number of vehicles such company owns, and vice versa

Future research should be conducted to determine whether there is a relationship between companies with a high turnover and the extent to which they implement environmental strategies. Companies with large warehouses in terms of square meters, and the extent to which they implement environmental strategies should be established. Companies with a large number of employees (> 200) should also be investigated to establish whether they are more aware of the environment than small companies with few employees (< 200).

## 5.7 BEST PRACTICE FRAMEWORK IN GREEN LOGISTICS FOR COMPANIES IN SOUTH AFRICA

In this section, a best practice framework in green logistics for logistics and transport companies in South Africa is introduced, followed by guidelines for large and small logistics and transport companies that these can be implemented according to the companies' organisational structure, resources, finances and time available to them.

The framework was drafted to achieve the primary objective of the study: *To develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice.* According to the results in Table 5.23, a framework was drafted and is depicted in Figure 5.24.

Figure 5.24 comprises the following sections: the *drivers of green logistics*, *best practices in green logistics management, and the barriers of green logistics*.

The input is the drivers of green logistics. These factors comprise the top five drivers rated by companies in Gauteng as the most important incentives or motivators for the implementation of green logistics practices, namely *reducing logistics costs, differentiating from competitors, gaining a competitive advantage, rising cost of fuel,* and *decreasing fuel bills.*

After companies have been motivated to implement green logistics practices, the implementation phase follows. This phase consists of the best practices in green logistics management, and is divided into three sections, namely *bulls eye best practices, future transformers best practices* and *back burners* and *can-do best practices.* The *bull's eye* best practices are top priority for implementation. Best practices in the *bull's eye* quadrant were rated as very important, and easy to implement. Large and small logistics and transport companies should strive to implement these practices because of its high importance and low level of difficulty. The *future transformers* best practices are second priority for implementation. These practices were rated as very important, but moderately to extremely difficult to implement. Large companies should strive to implement these practices, but SMEs should avoid these practices as they may be cost-intensive and could require a lot of resources and time. The *can-do* and *back burners* best practices are last priority as these practices are less important and difficult to implement.

By implementing these practices companies will achieve certain benefits. These benefits include *improving fuel efficiency, reducing emissions, establishing a competitive advantage, improving profits* and *enhancing CSR*. These benefits were rated as the top five reasons why companies in Gauteng should implement green logistics practices. By implementing these practices, the output is achieved, namely the reduction of the negative impact on the environment.

Although there are diverse benefits for the implementation of green practices, companies experience many barriers which prevent them from implementing green practices. In the current study, these barriers were rated as the top five reasons why companies in Gauteng struggle to implement green practices. The five barriers are:

- *lack of knowledge and experience;*
- *lack of training in GSCM;*
- *lack of professional treatment and long-term contracts for adopting GSCM from government;*
- *lack of management initiatives for transport and logistics;* and
- *lack of top-level management commitment.*

The best practice framework in Figure 5.24 can assist logistics and transport companies in South Africa in sustaining the practice.


**Figure 5.24: A BEST PRACTISE FRAMEWORK IN GREEN LOGISTICS**

### 5.7.1 Guidelines for logistics and transport companies in South Africa

#### *5.7.1.1 Guidelines for large companies*

Based on the framework in Figure 5.24, the following recommendations are made for large (> 200 employees) companies.

Large companies should determine in which sustainability phase the company currently is according to Dunphy *et al.*'s (2003) sustainability phase module (see figure 2.10).

- The first phase is *rejection*, where the senior executives are opposed against change. Companies that are currently in the rejection phase are opposed to government regulations and green activism, are exposed to a culture of exploration, and community claims are seen as illegitimate.
- The second phase is *non-responsiveness*, where senior executives are ignorant about sustainable transformation.
- The third phase is *compliance*, where senior executives are concerned with managing risk. Organisations in this phase are often characterised by maintaining a good citizen image by following pro-active measures and reducing risk and complying with minimum legal and community standards. There is little integration between HR and environmental functions.
- The fourth phase is *efficiency*, where senior executives are concerned with managing cost. Organisations in this phase aim to achieve higher productivity and efficiency, where environmental management is seen as a source of avoidable cost for the organisation.
- The fifth phase is *strategic pro-activity*, where senior executives are aiming to gain a competitive advantage. Organisations in this phase are focused on innovation, by seeking stakeholder engagement to innovate safe, environmentally friendly products and promote good citizenship to maximise profits and improve employee attraction.
- The sixth phase is the *sustainable corporation*, where senior executives' main focus and business values is transformation. The nature of the corporation is revised with the society and environment as the main focus point.

Large organisations are usually in phases three to six of transformation. Such organisations have more capital, human resources and time, they are more aware of their corporate image and corporate social responsibility, and they are under pressure from stakeholders and customers to conform to environmental standards. It is recommended that large companies aim to implement practices that were rated very important but easy to implement, as well as practices that are very important but moderately difficult to implement. Large companies can implement *bull's eye* and *future transformers* best practices as displayed in the framework in Figure 5.24.

The following practices, which lie in the *bull's eye* and *future transformers* quadrants, are suitable for large companies to implement.

**Table 5.36: Best practices in green logistics management for large companies to implement**

| **Recommended best practices in green logistics management for large companies to implement.** |
|---|
| **Changing truck fleets –** change of truck fleets and the standardisation of truck sizes promote the optimisation of freight and intermodal transportation. |
| **Creation of distribution centres –** creates an optimal solution for consolidating freight operations. |
| **Sustainable carrier selection –** selecting carriers that incorporate environmental practices in the services they provide. |
| **Installing an automatic warehousing system (AWS)** – this streamlines the processes within the warehouses, such as automatic storage and retrieval systems. |
| **Adapting facility design and construction/using a solar roof to save energy** – the layout and construction of warehouses directly influence the level of energy used. This includes installing **LED** lighting and fluorescent bulbs as well as more windows and fans for proper air circulation, and investing in motion sensor lighting. |
| **Conducting carbon footprint assessment –** companies can estimate the amount of $CO_2$ emissions generated by logistics activities by conducting a carbon footprint assessment. |
| **Adhering to green customer criteria gathering –** customers may decide to select logistics service providers if they conform to green standards and adhere to their "green criteria". |
| **Introducing and using tracking and tracing systems/satellite tracking/routing and load planning software –** implementing systems such as ERP and RFID to improve efficiency of daily operations. |
| **Environmental certifications –** companies should aim to receive an ISO14000 certificate by complying with environmental standards. |
| **Freight consolidation –** fewer trips are necessary by consolidating freight and less $CO_2$ emissions are produced. |
| **Selection of different equipment –** this entails selecting equipment that is environmentally friendly |

| Recommended best practices in green logistics management for large companies to implement. |
|---|
| such as electric forklifts or installing alternative power sources such as APUs. |
| **Fuel efficiency and using fuel saving devices–** increasing the use of biofuel or cleaner diesel. |
| **Process optimisation and load optimisation/ double stacking –** increase the optimal usage of space during transport. |
| **Energy efficiency –** reducing the amount of energy generated by installing alternative energy power sources such as APUs and refrigerated trailers. |
| **Minimisation of inventories –** frequent trips can reduce the number of inventories stored. |
| **On-site recycling, packaging recycling, use of ecological materials –** to encourage more environmentally friendly recycling. |
| **Publishing environmental footprint reports –** by publishing environmental footprint reports companies can attract new customers and clients, and gain new business contracts. |
| **Optimal routing planning –** management should reduce routes that are uneconomical and design routes that reduce distance, time and fuel. |
| **Moving a national DC operation to a regional DC operation and increase night-time deliveries –** by delivering freight at night faster turnaround times can be achieved due to less traffic congestion and road works. |
| **Reducing packaging and using different packaging technologies and material to reduce contamination –** eco-friendly materials can be used to make recycling more efficient. |
| **Developing relationships/communication –** these relationships can be formed between suppliers and buyers or customers and involve contracts or alliances. |
| **More frequent deliveries –** regular deliveries of small quantities can reduce $CO_2$ emissions. |
| **Distribution consolidation –** freights should be consolidated to reduce the number of trips and loading and unloading times on site. |
| **Multimodal transport and services –** making use of multimodal services to reduce carbon emissions by combining more environmental modes of transport, e.g. road to rail then to road again. |
| **Developing a strategic environmental plan –** management should include environmental management in their business strategy. |
| **Implementing an EMS, IMS and installing fleet management systems –** these systems could be implemented to streamline and integrate environmental goals in business activities or outputs. |
| **Transport collaboration/ Telematics –** to reduce the amount of carbon emissions generated and externalities such as air pollution and noise. |
| **Palletisation of cargo/Pallet and container pooling systems –** companies should aim to purchase reusable/recyclable pallet systems. |
| **Modal choice –** use environmentally friendly modes of transport such as railway transport and transporting less freight by road. |
| **Reconditioning and reusing pallets and containers –** purchase plastic pallets that can be recycled easier than wooden pallets. |
| **Disposing of products –** this entails on-site recycling by making use of "green packaging" or "ecological packaging" for more efficient recycling. |

| Recommended best practices in green logistics management for large companies to implement. |
| --- |
| **Using clean vehicles and installing new washing facilities–** purchasing hybrid and electric vehicles and increasing fuel efficiency to reduce oil usage. Rainwater can be used to clean vehicles.<br><br>**Selecting clean material handling equipment -** choosing more sustainable handling equipment such as electric forklifts instead of diesel forklifts, or operating equipment on biofuel.<br><br>**Euro IV lubricating oils** – this is subject to availability in certain regions.<br><br>**Monitoring fuel consumption –** trucks can be preset to switch off if they idle too long and waste fuel.<br><br>**Providing driver training-**fuel-saving tips for drivers and fuel management for transport operators.<br><br>**Reducing engine idling –** if a truck idles too long fuel is wasted and carbon emissions increased. Preset trucks to switch off when they idle too long. Provide driver training on engine idling.<br><br>**Bonus system to encourage drivers to drive safely and fuel-efficiently –** the bonus system can consist of rebates or monetary incentives.<br><br>**Monitoring fuel consumption –** by installing fuel monitoring equipment.<br><br>**Creating safety manuals –** this is specifically aimed at truck drivers.<br><br>**Promoting environmental awareness among managers –** managers should attend workshops and environmental training initiatives to acquire the necessary knowledge about the environmental impact of their daily operations, and to educate their employees.<br><br>**Providing incentives for green behaviour practices –** this can be in the form of rebates or monetary incentives.<br><br>**Publishing environmental efforts reports – t**his can enhance a company's green credentials and attract new customers. Environmental reports can improve companies' corporate image.<br><br>**Developing a formal environmental sustainability statement –** this can improve corporate social responsibility (CSR). |

By implementing these recommended practices large logistics companies will enjoy the benefits of going green.

#### *5.7.1.2 Guidelines for small and medium-sized companies (SMEs)*

According to the framework in Figure 5.24, the following recommendations are made for small and medium-sized companies (SMEs) (< 200 employees).

SMEs should determine in which sustainability phase the company currently is, namely the rejection, non-responsiveness, compliance, efficiency, pro-activity or sustainable corporation phase. SMEs are usually in the first to third phase of transformation. SMEs have less capital, human resources and time available. SMEs are under increasing pressure from stakeholders and suppliers to perform. It is recommended that SMES aim to implement practices that were rated as very important but easy to implement.

The following practices are suitable for SMEs to implement. These practices lie in the *bull's eye* quadrant of the framework in Figure 5.24.

**Table 5.37: Best practices in green logistics management for SMEs to implement**

| **Recommended best practices in green logistics management for SME to implement** |
|---|
| **Modal choice –** SMEs should aim to select more environmental and cost-friendly modes such as railway transportation, or a combination of rail and road transport (multimodal transport). |
| **Reconditioning and reusing pallets and containers –** SMEs should purchase plastic pallets instead of wooden pallets for easier recycling. |
| **Disposing of products –** this entails on-site recycling and making use of "green packaging" or "ecological packaging" for more efficient recycling. |
| **Palletisation of cargo and container pooling systems –** SMEs should aim to purchase reusable/recyclable pallet systems. Plastic pallets are more suitable for recycling than wooden pallets. Container pooling systems should be inspected and recycled on site, and not transported to another depot for inspection. This can reduce fuel consumption. |
| **Using clean vehicles –** this entails purchasing hybrid and electric vehicles and increasing fuel efficiency to reduce oil usage. |
| **Selecting clean material handling equipment –** choosing more sustainable handling equipment such as electric forklifts, or operate equipment on biofuel (when available in South Africa). |
| **Euro IV lubricating oils –** this is subject to availability in certain regions. |
| **Monitoring fuel consumption –** by installing fuel monitoring equipment. |
| **Reducing engine idling –** if a truck idles too long fuel is wasted and carbon emissions increased. Preset trucks to switch off if they idle too long. Provide driver training on engine idling. |
| **Providing driver training and fuel-saving tips for drivers –** managers of SMEs should initiate regular training workshops for drivers on a monthly basis on how to save fuel. |
| **Bonus system to encourage drivers to drive safely and fuel-efficiently –** the bonus system can be in the form of rebates or monetary incentives. |
| **Creating safety manuals –** this is specifically aimed at truck drivers. |
| **Promoting environmental awareness among managers –** managers of SMEs should attend workshops and environmental training initiatives to acquire the necessary knowledge about the environmental impact of their daily operations, and to educate their employees. |
| **Providing incentives for green behaviour practices –** this can be in the form of rebates or monetary incentives. Managers could encourage personnel to implement green activities by incorporating environmental scores in their performance agreement. |
| **Publishing environmental efforts reports** – this can enhance SMEs' green credentials and attract new customers and business contracts. Environmental reports can improve SMEs' corporate image and give them a competitive edge. |

| Recommended best practices in green logistics management for SME to implement |
|---|
| **Developing a formal environmental sustainability statement –** this can improve SMEs' corporate social responsibility (CSR). |
| **Communication-** SMEs should form relationships through communication with suppliers. |
| **Double stacking-** increase the optimal usage of space during transport. |

By implementing these practices SMEs will enjoy the benefits of going green.

Both large and small companies are advised not to implement practices in the *can-do* and *back burners* quadrant because they are of low importance and difficult to implement. The practices located in the *can-do* and *back burners* quadrant, which should be avoided, are *standardisation of truck sizes* and *using double-deck trailers to replace single-deck trailers*.

## 5.8 CONCLUSION

In this chapter, the empirical results and findings were discussed. The results were displayed by means of graphs, figures and tables.

Firstly, the descriptive analysis was discussed, where the general information of the questionnaire (Section A) was interpreted. The general information included the respondent's position in the company, company turnover per annum; number of employees in the company, number of vehicles in the company, warehouses in square meters, status of the company and awareness of green logistics. Descriptive statistics were also used to discuss section B of the questionnaire, namely the drivers, benefits and barriers of green logistics.

Secondly, an opportunity analysis was conducted of the best practices in relation to the importance and difficulty of implementing strategic, tactical, operational, organisational, technical and internal best practices. The opportunity analysis was reported on by means of tables and radar graphs.

Thirdly, in section 5.4, portfolio matrixes were used to illustrate the importance of green logistics practices in relation to the difficulty of implementing these practices. The portfolio matrixes consisted of four quadrants, namely the *future transformers*, *bull's eye*, *can-do* and *back burners* quadrant. The results from the portfolio matrixes were used to compile Table 5.23, which consisted of the best practices that lie within each of the four quadrants.

Fourthly, inferential statistics were used to test whether there was a statistical difference between the two employee groups, namely SMEs (< 200 employees) and large companies (> 200 employees) regarding their perceptions of the best green logistics practices, and the drivers, barriers and benefits of implementing green logistics practices. Valuable results were discussed regarding the perceptions SMEs and large organisations have regarding the importance and difficulty of implementing green logistics practices.

Fifthly, cross-tabulations were used in section 5.6 to determine whether there is a relationship between the following variables: *company turnover vs. number of employees*, *company turnover vs. warehouses in square meters*, and *company turnover vs. number of vehicles*. All three cross-tabulations indicated a positive result between the two variables.

Finally, in section 5.7 a best practice framework in green logistics for companies in South Africa was proposed in order to achieve the primary objective of the study, namely *to develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice.*

This framework was drafted using the results summarised in Table 5.23. Recommendations for the implementation of green logistics practices for SMEs and large companies were made.

The next chapter will entail the conclusions and recommendations of the study.

# CHAPTER 6

# CONCLUSIONS AND RECOMMENDATIONS OF GREEN LOGISTICS FOR COMPANIES IN SOUTH AFRICA

## 6.1 INTRODUCTION

In this chapter, the conclusions and recommendations derived from the study are presented. The conclusions are summarised according to the objectives of the study. As stated in Chapter 1, a literature review was conducted and this is reported on in Chapters 2 and 3 to meet the first four secondary objectives of the study, namely –

- to identify the main drivers behind implementing green logistics practices;
- to explore the benefits of implementing green logistics practices;
- to determine the barriers preventing companies from implementing green logistics practices; and
- to explore green logistics practices of logistics and transport companies located in Gauteng.

After the literature review had been conducted, a Lime survey was drafted according to the literature findings in Chapters 2 and 3, where the main drivers, benefits and barriers of green logistics were tested among logistics and transport companies in Gauteng. The Lime survey also explored the green logistics practices of logistics and transport companies located in Gauteng.

According to the results of the survey, the last two secondary objectives of the study were met namely –

- to compare green logistics activities of SMEs and large companies in Gauteng; and
- to provide large companies and SMEs with guidelines on how to implement green logistics practices.

Finally, the primary objective of the study was achieved by using the findings in the literature as well as the results of the empirical study. The primary objective of this study was to develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice.

The outline of this chapter is as follows:

- summary of findings-literature study in section 6.2;
- summary of findings-empirical study in section 6.3;
- recommendations in section 6.3;
- future research in section 6.4; and
- conclusions in section 6.5

## 6.2 SUMMARY OF FINDINGS – LITERATURE STUDY

In this section, conclusions are drawn from findings in the literature study reported in Chapters 2 and 3. A summary of the findings is presented in –

- Chapter 2 – Conceptualisation of green logistics and sustainability; and
- Chapter 3 – Drivers, barriers and benefits of global green logistics practices

### 6.2.1 A summary of the findings on the conceptualisation of green logistics and sustainability

In Chapter 2 of the study, a comprehensive overview on the conceptualisation of green logistics and sustainability was discussed based on the findings from literature. This section provides a summary of the findings on an overview of South Africa's logistics costs.

The main components of logistics costs in South Africa were discussed in section 2.2. Logistics costs can be divided into three direct elements, namely transport, storage and handling costs, management and administration costs, and one indirect element, namely inventory-carrying costs. It was found that there is a positive link between the provincial logistics capability (PLC) of a province and the provincial economy. The Western Cape has the highest logistics costs as well as transportation costs. Gauteng has the second-highest transport costs and highest inventory carrying costs. Mpumalanga is ranked third after the Western Cape and Gauteng, with the third-highest transport costs, followed by KwaZulu-Natal, Eastern Cape, Limpopo, Northern Cape, Free State and North West. The top three provinces that contribute most to

South Africa's economy, namely Gauteng, KwaZulu-Natal and the Western Cape, are the provinces with the best road infrastructure in South Africa. Ten key objectives and constraints were identified by respondents in the Barloworld Logistics Survey (2014). The main issue regarding high freight volumes being transported by road and not rail, and the impact on the environment and deteriorating road conditions were highlighted and discussed in section 2.2.

- **The dimensions of sustainability and green logistics**

In section 2.3, the meanings of sustainability and SSCM were discussed. Three dimensions of sustainability were identified, namely economic, environmental and social sustainability. Economic sustainability emphasises that logistics and transport firms must constantly attempt to reduce their total supply chain costs through balancing sustainable and strategic initiatives (Bowersox *et al.*, 2013). Van Marrewijk (2003) broadly defines CSR as firms displaying environmental and social concerns in business operations including interactions with stakeholders. Environmental sustainability can further be divided into three sections, namely conservation, usage reduction and business management practices (Bowersox *et al*., 2013). The concept of transport system sustainability was also discussed.

- **SMEs' adoption towards environmental initiatives**

In section 2.4, SMEs' adoption of environmental initiatives was discussed. Nine aspects that influence the development of SMEs' environmental strategies, were identified and discussed.

- **Financial resources:** The lack of financial and technical resources, unavailability of capital, as well as the high cost of environmental programmes are only few of the barriers identified as some of the main reasons SMEs struggle to adopt environmental practices.
- **Organisational structure:** Certain studies have revealed that the particular features of an SME's organisational structure can obstruct the implementation of environmental actions.
- **Management style:** Commitment, technical skills, existence of environmental awareness and expertise are important characteristics management should have in order to motivate staff to adopt these initiatives.

- **Human resources:** Employees working for SMEs typically have little knowledge of the environment. Training programmes for staff members to promote environmental behaviour should be enforced. Management should be able to motivate staff and create awareness of environmental practices among staff members by dedicating time and effort to create environmental programmes or training guides for employees.
- **Environmental management status:** The idea of allocating personnel to a specific department which manages environmental issues is increasingly becoming more popular (Del Brio & Junquera, 2003).
- **Manufacturing activity:** Globally, manufacturing organisations are compelled to evaluate the environmental damage caused by manufacturing processes.
- **Technological approach:** One of the main disadvantages SMEs face is the lack of finances and capital resources. Therefore, it is more difficult for small firms than for large firms to acquire green technologies due to their lack of resources.
- **Innovative capacity:** Noci and Verganti (1999) conducted a study on the management of green product innovation in small firms, and concluded that SMEs can adopt well-developed environmental strategies, provided that SMEs have high levels of innovative capacity.
- **External cooperation:** External relationships with third-party logistics services, public administration and research institutions can be seen as another disadvantage or obstacle for SMEs, due to SMEs' restricted capacity to form new relationships (Del Brio & Junquera, 2003; Noci & Verganti, 1999).

The drivers and barriers which influence SMEs to take part in environmental and sustainable initiatives were grouped into two categories. The first category referred to SMEs' capabilities, and the second category to SMEs' supply network. The first category, *SMEs' capabilities*, dealt with areas where management and the organisation play an important role in encouraging environmental behaviour. Finance was also included in this group. The second category, *SMEs' supply network,* dealt with areas where external factors play a role, such as pressure from customers, laws and regulations. These drivers and barriers were summarised in Tables 2.4 to 2.9 in Chapter 2.

In order to assist companies with the transformation process towards more sustainable organisations, Dunphy *et al.* (2003) composed a useful framework called the sustainability phase model that expresses the six phases organisations go through in order to achieve sustainability. The sustainability phase model is displayed in Figure 2.10 and the six phases namely rejection, non-responsiveness, compliance, efficiency, strategic proactivity and the sustaining corporation were discussed in detail in section 2.4.3.

- **Logistics decisions that affect the environment (see section 2.5)**

In section 2.5, six elements were identified and discussed namely:

  - *Raw material acquisition*: Wu and Dunn (1995) describe raw material acquisition as the purchasing activities and logistical arrangements that bring the essential inputs to the organisation. The demand for environmentally friendly raw material is increasing as the demand for 'green products' rises. Purchasing managers will have to make sure their suppliers comply with the International Organisation for Standardisation's (ISO) 1400 standards.
  - *Inbound logistics*: This refers to the receiving, storage and movement of raw materials from suppliers or vendors into production processes or storage facilities (Coyle *et al.*, 2003).
  - *Transformation:* Transformation is the process of taking inputs and changing them into final products via assembly, testing, and packaging activities.
  - *Outbound logistics:* These are the activities associated with the movement and storage of products from the end of the production line to the end consumer (Coyle *et al.*, 2003).
  - *Marketing:* Logistics play a key role in the marketing concept, to ensure goods and services are delivered at the right place and at the right time therefore adhering to customer requirements and needs.
  - *After sales service:* Consists of returns handling, parts management and service network.

- **Green logistics initiatives implemented in SA companies**

In section 2.6, certain companies from different industries were identified and their green initiatives were discussed. These companies were Woolworths, Volkswagen, Nissan, Standard

Bank, Imperial Logistics and the service provider, Pikitup. Various green logistics initiatives implemented globally were summarised in Table 2.10.

- **Paradoxes of green logistics**

In section 2.7, the paradoxes of green logistics were identified and discussed. Six dimensions were investigated to identify the discrepancies between the logistics industry and the environment. These six dimensions were costs, network, time, reliability, warehousing and e-commerce.

### 6.2.2 Summary of the findings on the global green logistics practices

Chapter 3 of the study dealt with global green logistics practices that international logistics companies are currently implementing. The drivers, barriers and benefits of implementing green logistics practices were identified and discussed (see section 3.3). A summary of the literature of Chapter 3 is provided in section 6.2.2.1 to 6.2.2.2 below.

#### *6.2.2.1 Best practices in green logistics*

In this section, the best practices in green logistics management are summarised. As discussed in Chapter 3 (3.2.1 to 3.2.2), best green logistics practices can be implemented at six hierarchical levels of a company, namely strategic, tactical, operational, organisational, internal and technical. These best practices are summarised in Table 6.1 below.

**Table 6.1: Summary of best green logistics practices**

| Strategic best practices | Tactical best practices | Operational best practices | Organisational best practices | Internal best practices | Technical best practices |
|---|---|---|---|---|---|
| • Change of truck fleets<br>• Stan-dardisation of truck sizes<br>• Creation of DCs<br>• Sustainable carrier selection | • Palletisation of cargo<br>• Freight consolidation<br>• Reuse of pallets and containers<br>• Modal choice<br>• Selection of different | • Carbon footprint assessment<br>• Clean vehicles<br>• Fuel efficiency<br>• Load optimisation<br>• Clean material | • Communica-tion<br>• Developing relationships<br>• Developing a strategic environmental plan<br>• Distribution consolidation | • Bonus system to encourage drivers to drive safely and fuel-efficiently<br>• Creating safety manuals<br>• Fuel-saving tips for | • Electric forklift trucks instead of diesel<br>• Euro IV lubricating oils<br>• Exchanging diesel vehicles for electric |

| | | | | | |
|---|---|---|---|---|---|
| • AWSs<br>• Facility design and construction<br>• Carbon footprint assessment<br>• Green customer criteria gathering<br>• Introduction of tracking and tracing systems | equipment<br>• Re-conditioning and reuse of pallets and containers<br>• Disposing of products<br>• Environ-mental certifications<br>• Pallet and container pooling systems<br>• Use of different packaging technologies and materials to reduce conta-mination | handling equipment<br>• Fuel efficiency<br>• Energy efficiency<br>• Process optimisation<br>• Minimisation of inventories<br>• On-site recycling<br>• Environ-mental footprint reports<br>• Use of tracking and tracing systems to improve operations performance | • Double stacking<br>• Fuel management for transport operators - training of drivers, new technology<br>• Implementa-tion of an EMS<br>• IMS<br>• Multimodal services: road to rail then to road again<br>• Night-time deliveries<br>• Optimal routing planning<br>• Optimising load fill<br>• Organisational practices<br>• Reducing packaging<br>• Transport collaboration | drivers<br>• Implementa-tion of a guidance and communicati on system<br>• Internal practices<br>• Monitoring fuel consumption by installing fuel monitoring equipment<br>• Personnel training<br>• Promoting environ-mental awareness among senior personnel<br>• Promoting internal training programmes<br>• Reducing carbon footprint<br>• Reducing engine idling | vehicles<br>• Installing fleet management systems<br>• Installing new (modern) washing facilities<br>• Installing software to reduce, measure and monitor fuel consumption<br>• Installing routing software<br>• Load optimisation<br>• Load planning software<br>• Monitoring fuel consumption<br>• Satellite tracking<br>• Solar roof to save energy<br>• Telematics<br>• Developing a double-deck trailer to replace single-deck trailers<br>• Using intermodal transport<br>• Using rainwater for vehicle cleaning |

In the survey, participants were required to give feedback on the best practices summarised in Table 6.1 above, and the importance and difficulty of each practice were rated among logistics and transport companies in Gauteng.

#### *6.2.2.2 Barriers, drivers and benefits of green logistics practices*

In this section, the drivers, benefits and barriers of green logistics are summarised. The drivers of green logistics are summarised below in Table 6.2.

**Table 6.2: Summary of the drivers of green logistics**

| **Drivers of green logistics** |
|---|
| Achieve legislative and regulatory compliance |
| Compliance with regulations |
| Collaboration with customers |
| Decreasing fuel bills |
| Decreasing risk |
| Desire to be regarded a leader in sustainability |
| Developing alternative networks |
| Differentiation from competitors |
| Financial return on investment (ROI) |
| E-logistics and environment |
| Gaining competitive advantage |
| Government compliance |
| Improving corporate image |
| Improving customer and investor relations |
| Improving firm performance |
| Improving public relations |
| Improving quality |
| Increasing supply chain efficiency |
| Investor pressure |
| ISO14000 certification |
| Marketing pressures |
| Optimising logistics flow |
| Part of CSR |
| Pressure by environmental advocacy groups |
| Pro-active action pre-regulation |
| Reducing logistics costs; desire to reduce costs |
| Rising cost of fuel |
| Rising cost of transportation |
| Satisfying customer requirements |
| Supplying integration |

These drivers of green logistics are discussed in detail in Table 3.5.

The benefits of green logistics are summarised in Table 6.3.

**Table 6.3: Summary of the benefits of green logistics**

| Benefits of green logistics |
|---|
| Reducing overall business costs |
| Enhancing CSR |
| Improving profits |
| Reducing waste/improving waste disposal |
| Improving visibility of green supply drivers |
| Increasing use of recyclables |
| Improving fuel efficiency |
| Reducing emissions |
| Developing new products/Winning new customers |
| Reducing use of toxic materials |
| Improving employee satisfaction |
| Benefits of the green supply chain |
| Improving brand image |
| Satisfying customer requirements |
| Differentiating from competitors |
| Reducing logistics costs |
| Establishing a competitive advantage |
| Optimising logistics flow |
| Expanding to new markets |
| Optimising manufacturing |
| Reducing manufacturing costs |

These benefits of green logistics are discussed in detail in Table 3.6.

The barriers of green logistics are summarised in Table 6.4.

**Table 6.4: Summary of the barriers of green logistics**

| **Barriers of green logistics** |
|---|
| Cost of implementation for GSCM |
| Customers' unawareness of GSCM products and services |
| Lack of acceptance of advancement in new technology |
| Lack of energy management and waste management of the organisation |
| Lack of external sustainability audits for suppliers and contractors |
| Lack of government initiative system for GSCM practitioners |
| Lack of green architects, consultants, green developers, contractors in the region |
| Lack of integration of IT systems |
| Lack of internal sustainability audits within the organisation |
| Lack of knowledge and experience |
| Lack of management initiatives for transport and logistics |
| Lack of professional treatment and long-term contracts for adopting GSCM from government |
| Lack of skilled HR professionals in sustainability and GSCM |
| Lack of sustainability certification, like ISO 14001 |
| Lack of top-level management commitment |
| Lack of training in GSCM |
| Poor implementation of green practices within a supply chain |
| Poor organisational culture in GSCM |
| Suppliers' flexibility to change towards GSCM |
| Uncertainty and competition in market |

The barriers of green logistics were discussed in detail in Table 3.7. The drivers, benefits and barriers were identified in the literature and tested in the online survey.

## 6.3 SUMMARY OF FINDINGS OF THE EMPIRICAL STUDY

In this section, a summary of the results of the survey are discussed. A Lime survey was sent to 160 managers of logistics and transport companies operating in Gauteng. A response rate of 22.5% was achieved (see section 5.1). Data-analysis was conducted by means of descriptive statistics (see section 5.2), an opportunity analysis (see section 5.3), portfolio matrix (see section 5.4), inferential statistical interpretation (see section 5.5) and cross-tabulations (see section 5.6).

### 6.3.1 Summary and findings of descriptive research

The results of sections A and B of the questionnaire are discussed in this section.

#### *6.3.1.1 Summary of the results of the general information (Section A)*

A summary of the findings of section A in the form of bullet points is provided below:

- Question 1 of the questionnaire consisted of the information participant sheet, where respondents indicated that they accepted and agreed to the terms and conditions of participating in the survey.
- In question 2 of the questionnaire, respondents were asked to indicate their position in the company. Of the respondents, 58.3% were middle-level managers and 12% were top-level managers. Only 3% of the respondents were from lower-level management.
- Question 3 of the questionnaire asked respondents to indicate the company turnover per annum. The results showed that –
  - 5.6% of the companies' turnover per annum was less than R10 million;
  - 16.7% was between R10 million and R100 million;
  - 5.6% was between R101 million and R150 million;
  - 11.1% of the companies' turnover per annum was between R151 million and R500 million;
  - 58.3% of the companies had a turnover of more than R500 million rand; and
  - only 2.8% of the respondents were unsure about their companies' turnover.
- Question 4 of the questionnaire asked respondents to indicate the number of employees in the company.
  - 25% had fewer than 100 employees;
  - 8.3% had between 100 and 200 employees;
  - 11.1% had between 201 and 1 000 employees;
  - 22.2% had between 1 001 and 10 000 employees, and
  - 33.3% had more than 10 000 employees.
- Question 5 of the questionnaire asked respondents to indicate the number of vehicles in the company.

- 11.1% had fewer than 10 trucks and more than 10 000 trucks in their company;
- 22.2% of the companies had between 10 and 100 trucks, and between 1 001 and 10 000 trucks;
- 27.8% owned between 101 and 1 000 trucks; and
- only 5.6% of the respondents were unsure about the number of trucks they owned.

- Question 6 of the questionnaire asked respondents to indicate the size of their warehouses in square meters.
  - 19.4% indicated their warehouses were below 10 000 $m^2$;
  - 13.9% of the companies' warehouses were between 10 000 $m^2$ and 20 000 $m^2$;
  - 2.8% of the warehouses were between 20 001 $m^2$ and 30 000 $m^2$;
  - 8.3% between 30 001 $m^2$ and 40 000 $m^2$;
  - 30.6% over 40 000 $m^2$; and
  - 25% of the respondents indicated they were unsure.
- Question 7 of the questionnaire asked respondents to indicate the status of the company they worked for.
  - 52.8% of the respondents indicated that they worked at the head office of the company;
  - 8% were part of a holding company;
  - 5.6% were employed at a branch;
  - 2.8% worked at an independent unit;
  - 25% at a subsidiary; and
  - 5.6% indicated they worked at other options.
- Question 8 of the questionnaire asked respondents to indicate whether they were aware of the concept of green logistics. This question was specifically asked to estimate how many companies in Gauteng are aware of Green Logistics. Of the respondents, 78% indicated they were aware of the concept of green logistics while 22% were not aware of green logistics.

#### *6.3.1.2 Summary of the results of the drivers, benefits and barriers of green logistics (Section B)*

In section B of the questionnaire, respondents were asked to rate the importance of the drivers, benefits and barriers of green logistics on an importance scale from 1–5. A summary of the findings of section B is provided below.

##### *6.3.1.2.1 Summary of the drivers of green logistics*

The respondents rated *reducing logistics costs* (D17) as the main driver for implementing green logistics practices with a mean value of 4.47. This was perceived as the main incentive for companies to implement green logistics practices. *Differentiating from competitors* (D18) and *gaining a competitive advantage* (D7) were ranked as the second-most important drivers, both with a mean value of 4.44. *Rising cost of fuel* (D15) was ranked as the third-most important driver with a mean value of 4.42. *Decreasing fuel bills* (D5) was ranked as the fourth-most important driver with a mean value of 4.39. *Increasing supply chain efficiency* (D6) and *compliance with government regulations* (D9) were ranked as the fifth-most important drivers, both with a mean value of 4.33.The drivers with the lowest scores and perceived as the least important were *improving investor relations* (D14), ranked as the least important driver with a mean value of 3.83 and *improving public relations* (D1), ranked as the second-least important driver with a mean value of 3.89.

##### *6.3.1.2.2 Summary of the benefits of green logistics*

The respondents rated *improving fuel efficiency* (B19) as the main benefit for implementing green logistics practices with a mean value of 4.50. This was perceived as the main benefit encouraging companies to implement green logistics practices. *Reducing emissions* (B11) and *establishing a competitive advantage* (B7) were ranked as the second-most important benefits, both with a mean value of 4.45. *Improving profits* (B6)*, enhancing corporate social responsibility* (B5)*, and reducing overall business costs* (B4) were ranked as the third-most important benefits, all with mean values of 4.39. *Reducing logistics costs* (B14) was ranked as the fourth-most important benefit with a mean value of 4.34. *Reducing waste/improving disposal* (B8) ranked as the fifth-most important benefit with a mean value of 4.33.

The benefits with the lowest scores and perceived as the least important were: *optimising manufacturing* (B15), ranked as the least important benefit with a mean value of 3.75 and *reducing manufacturing costs* (B16), ranked as the second-least important benefit with a mean value of 3.81.

##### *6.3.1.2.3 Summary of the barriers of green logistics*

*Lack of knowledge and experience* (Ba12) was rated as the main barrier for implementing green logistics practices with a mean value of 4.18. *Lack of training in green supply chain management (GSCM)* (Ba14) was ranked as the second-most important barrier with a mean value of 4.11. *Lack of professional treatment and long-term contracts for adopting GSCM from government* (Ba18) was ranked as the third-most important barrier with a mean value of 4.07. *Lack of management initiatives for transport and logistics* (Ba19) was ranked as the fourth-most important barrier with a mean value of 4.04. *Lack of top-level management commitment* (Ba8) was ranked as the fifth-most important barrier with a mean value of 4.00.

The barriers with the lowest scores and perceived as the least important were: *lack of integration technology systems* (Ba1), ranked as the least important barrier with a mean value of 3.62 and *lack of acceptance of advancement in new technology* (Ba2), with the same mean value of 3.62.

### 6.3.2 Summary and findings of the opportunity analysis

In this section, a summary of the analysis of section C of the questionnaire is discussed with regard to best practices in green logistics management in terms of the importance and difficulty of implementing the practice. A summary of the findings of section C will be provided below:

- **Strategic best practices**

*Introducing tracking and tracing systems* (St17) was rated as the most important strategic best practice to implement with a mean value of 4.48, but it was also rated as moderately difficult to implement with a mean value of 3.43. This can be due to the high amount of capital needed to implement such systems. *Carbon foot print assessment* (St13) was rated as the second-most important strategic best practice with a mean value of 4.36. However, companies reported that they found it moderately difficult to implement this practice with a mean value of 3.22. This can be the result of a lack of industry experts in the field conducting carbon footprint assessments for companies in South Africa. *Facility design and construction* (St11) was rated the most difficult practice to implement with a mean value of 3.70, and an importance rate of 3.96. Although companies found this practice very important, they also found it very difficult to implement. Companies, especially SMEs, may find it hard to change the design and construction of their facilities as finance is a major problem for them. *Change of truck fleets* (St1) was also rated as a most difficult practice to implement with the same mean value of 3.70 and an importance score of 3.78. This practice can be seen as moderately to very difficult to implement, and somewhat to very important. Changing of truck fleets require a large amount of capital that many companies may see as unnecessary.

- **Tactical best practices**

*Environmental certifications* (Ta13) was rated as the most important tactical best practice to implement with a mean value of 4.13. Although this had the highest importance score, environmental certifications was also rated as the most difficult practice to implement with a mean value of 3.70. Companies awarded with environmental certifications could use this to attract new clients, improve their corporate image and be seen as the leaders in sustainability. *Freight consolidation* (Ta3) was rated as the second-most important tactical best practice to implement with a mean value of 3.96, and a difficult to implement mean value of 3.43. This practice can be seen as very important, but moderately difficult to implement. Freight consolidation can be achieved by large and small companies by bundling various small shipments together. This was rated as moderately difficult to implement. *Selection of different equipment* (Ta7) was rated as the second-most difficult tactical practice to implement with a mean value of 3.43. Although having a high importance rate of 3.91, many companies could find it moderately difficult to implement because of equipment available for them to choose from.

- **Operational best practices**

*Fuel efficiency* (Op3) and *energy efficiency* (Op9) were rated as the most important operational best practices to implement with a mean value of 4.48. The difficulty of implementing fuel efficiency had a mean value of 3.13 and energy efficiency, 3.22. Companies viewed fuel efficiency and energy efficiency as very important, and moderately difficult or almost very easy to implement. *Process optimisation* (Op11) was rated as the second-most important operational practice to implement with a mean value of 4.43. Although process optimisation was seen as very important, it was also rated as very difficult to implement, with a mean value of 3.65. *Minimisation of inventories* (Op13) was rated as the second-most difficult practice to implement with a mean value of 3.57, and was seen as very important with a mean value of 4.17.

- **Organisational best practices**

*Fuel management for transport operators, training of drivers and new technology* (Or31) was rated as the most important organisational best practice to implement with a mean value of 4.81, and it was seen as moderately difficult to implement with a mean value of 3.33. *Optimal routing planning* (Or1) was rated as the second-most important organisational practice with a mean value of 4.7, and a difficulty to implement value of 3.29. *Multimodal services* (Or19) was rated as the most difficult practice to implement with a mean value of 3.86. Although this practice is seen as very difficult to implement, it is also rated as very important with a mean value of 3.86. *Integrated management system* (IMS) (Or25) was rated as the second-most difficult practice to implement with a mean value of 3.81, and rated as very important with a mean value of 4.19.

- **Technical best practices**

*Monitoring fuel consumption* (Te15) and *satellite tracking* (Te21) were rated as very important to implement with a mean value of 4.52. Monitoring fuel consumption was seen as easy to implement with a difficulty of implementing score of 2.48. Satellite tracking was seen as moderately difficult to implement with a mean value of 3.05. *Installing fleet management systems* (Te1) was rated as the second-most important practice with a mean value of 4.43, and rated as moderately difficult to implement with a mean value of 3.14. *Exchanging diesel vehicles for electric vehicles* (Te19) was rated as the most difficult practice to implement with a mean value of 4.05, and seen as somewhat important. *Solar roof to save energy* (Te33) was rated as the second-most difficult practice to implement with a mean value of 3.76. Due to the high costs of implementing these practices, companies might struggle to implement them.

- **Internal best practices**

*Driver training* (In5) was rated as extremely important to implement with a mean value of 4.86, and easy to implement with a mean value of 2.71. *Promoting environmental awareness among managers* (In13) was rated as extremely important with a mean value of 4.57. *Bonus system to encourage drivers to drive safely and fuel-efficiently* (In7) was rated as the most difficult practice to implement with a mean value of 4.43. *Providing incentives for green behaviour practices* (In15) was rated as the second-most difficult practice to implement with a mean value of 2.95. Although moderately difficult to implement, this practice was regarded as very important.

### 6.3.3 Summary and findings of the portfolio matrix

In section C of the questionnaire, respondents were asked to rate the importance of strategic, tactical, operational, organisational, technical and internal best practices in relation to the difficulty of implementing these practices. A portfolio matrix was used to display the results. A summary of the findings of the portfolio matrix is provided below:

Each portfolio matrix consisted of four quadrants, namely:

*Future transformers* (key long-term) opportunities: This quadrant signifies those best practices with a high level of importance (mean values equal to or more than 3) and a high level of difficulty to implement (mean value equal to or more than 3). Resources and time are needed to implement these practices.

*Bull's eye* (key immediate) opportunities: This quadrant signifies those best practices with a high level of importance (mean equal to or more than 3) and a low level of difficulty to implement (mean values less than 3). Only a few resources and little time are needed to implement the practices.

*Back burners* opportunities: This quadrant signifies those best practices with a low level of importance (mean value less than 3) and a high level of difficulty to implement (mean value equal to or more than 3). High impact on resources and time is needed to implement these practices.

*Can-do* opportunities: This quadrant signifies those best practices with a low level of importance (mean values less than 3) and a low level of difficulty to implement (mean values less than 3). Only a few resources and little time are needed to implement the practices. The portfolio matrix for each of the best practices is discussed below.

Summary of the survey results are provided below in Table 6.5.

**Table 6.5: Summary of the best practices located in each quadrant**

| **Best practices in the *future transformers* quadrant – high level of importance, moderate to high level of difficulty** |
|---|
| • Changing truck fleets<br>• Creating distribution centres<br>• Sustainable carrier selection<br>• AWS<br>• Facility design and construction<br>• Carbon footprint assessment<br>• Green customer criteria gathering<br>• Introducing tracking and tracing systems<br>• Environmental certifications<br>• Freight consolidation<br>• Selecting different equipment<br>• Using different packaging technologies and material to reduce contamination<br>• Fuel efficiency<br>• Load optimisation<br>• Energy efficiency<br>• Process optimisation<br>• Minimisation of inventories<br>• On-site recycling, packaging recycling, use of ecological materials<br>• Environmental footprint reports<br>• Using tracking and tracing systems to improve operations performance<br>• Carbon footprint assessment<br>• Optimal routing planning<br>• Moving a national DC operation to a regional DC operation<br>• Night-time deliveries<br>• Optimising load fill |

- Reducing packaging
- Developing relationships
- More frequent deliveries
- Distribution consolidation
- Multimodal services, e.g. road to rail then to road again
- Developing a strategic environmental plan
- Implementing an EMS
- IMS
- Transport collaboration
- Fuel management for transport operators, training of drivers, new technology
- Installing fleet management systems
- Telematics
- Using fuel saving devices
- Installing new washing facilities
- Use of multimodal transport
- Use of rainwater for vehicle cleaning
- Exchanging diesel vehicles for electric vehicles
- Satellite tracking
- Load optimisation
- Installing routing software
- Electric forklift trucks instead of diesel
- Installing software to measure, monitor and reduce fuel consumption
- Load planning software
- Solar roof to save energy

**Best practices in the *bull's eye* quadrant – high level of importance, low level of difficulty**

- Palletisation of cargo
- Modal choice
- Reconditioning and reusing of pallets and containers
- Disposing of products
- Pallet and container pooling systems
- Using clean vehicles
- Clean material handling equipment
- Euro IV lubricating oils
- Monitoring fuel consumption and fuel-saving tips for drivers

| |
|---|
| • Reducing engine idling<br>• Driver training<br>• Bonus system to encourage drivers to drive safely and fuel-efficiently<br>• Monitoring fuel consumption by installing fuel monitoring equipment<br>• Creating safety manuals<br>• Promoting environmental awareness among managers<br>• Providing incentives for green behaviour practices<br>• Publishing environmental efforts reports<br>• Developing a formal environmental sustainability statement<br>• Double stacking<br>• Communication |
| **Best practices in the *back burners* quadrant – low level of importance, high level of difficulty** |
| • Standardisation of truck sizes |
| **Best practices in the *can-do* quadrant –low level of importance, low level of difficulty** |
| • Using double-deck trailers to replace single-deck trailers |

Table 6.5 was used to compile the framework in green logistics in Chapter 5 (see section 5.7). The framework was drafted to achieve the primary objective of the study, namely to develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice. According to the framework, guidelines were provided for SMEs and large logistics and transport companies in South Africa to assist them in sustaining the practice.

### 6.3.4 Summary and findings of the inferential statistics

In this section, a summary is provided of the perceptions of the two employee groups (< 200 and 200 and above) regarding the importance and difficulty of implementing strategic, tactical, operational, organisational and internal best practices. The employee groups were divided into two groups. Group 1 comprised SMEs with fewer than 200 employees. Group 2 comprised large logistics companies with more than 200 employees. The aim was to test whether or not there was a statistically significant difference between small and large companies' perceptions of the practices. A Mann–Whitney U nonparametric test was used to test the statistical significance of each of the best practices.

6.3.4.1 Summary of the results for best practices in green logistics management

In this section, the following hypotheses are discussed:

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their importance rating regarding green logistic practices.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their importance rating regarding green logistic practices.

The results indicate that there is a statistically significant difference at the 5% level of significance, between the employee groups with regard to palletisation of cargo ($p$ = 0.036) and environmental certifications ($p$ = 0.044). Furthermore, the mean ranks indicate that the group with 200 and more employees tended to consider these two practices as more important (mean ranks of 13. 74 and 13.71 respectively) than the group with fewer than 200 employees (with mean ranks of 7.08 and 7.17) respectively.

- None of the strategic best practices (St1–St17) differed statistically significantly between the employee groups, as depicted in Table 5.25. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the practices *standardisation of truck sizes*, *creation of CDs*, *sustainable carrier selection* and *green customer criteria collection* as slightly more important than the larger employee groups.
- None of the operational (Op1–Op21) best practices differed statistically significantly between the employee groups, as displayed in Table 5.26. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the practices *use of clean vehicles*, *fuel efficiency*, *clean material handling equipment* and *energy efficiency* as slightly more important than the larger employee groups.
- None of the organisational (Or1–Or31) best practices differed statistically significantly between the employee groups, as displayed in Table 5.27. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the practices *use of clean vehicles*, *fuel efficiency*, *clean material handling*

*equipment* and *energy efficiency* as slightly more important than the larger employee groups.

- None of the technical (Te1-Te33) best practices differed statistically significantly between the employee groups as depicted in Table 5.28. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the practices *installing new washing facilities*, *using double-deck trailers to replace single-deck trailers*, *using multimodal transport*, *load optimisation* and *installing software to monitor and reduce fuel consumption* as slightly more important than the larger employee groups.
- None of the internal best practices (In 1–In19) differed statistically significantly between the employee groups. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider certain practices as slightly more important than the larger employee groups, namely:
  - *fuel-saving tips for drivers*;
  - *reducing engine idling*;
  - *driver training*;
  - *bonus system to encourage drivers to drive safely and fuel-efficiently*;
  - *monitoring fuel consumption by installing fuel monitoring equipment*;
  - *creating safety manuals*;
  - *promoting environmental awareness among managers*; and
  - *providing incentives for green behaviour practices*.

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the drivers of green logistics.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the drivers of green logistics.

The results indicate that there is a statistically significant difference at the 10% level of significance between the employee groups with regard to decreasing fuel bills ($p$ = 0.021) and decreasing risk ($p$ = 0.013). Furthermore, the mean ranks indicate that the group with 200 and fewer employees tended to consider these two practices as more important (mean ranks of

23.58 and 24.21 respectively) than the group with more than 200 employees (with mean ranks of 15.96 and 15.65 respectively).

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the benefits of green logistics.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the benefits of green logistics.

The results indicate that there is a statistically significant difference at the 10% level of significance between the employee groups with regard to improving profits ($p$ = 0.097) and winning new customers ($p$ = 0.030). Furthermore, the mean ranks indicate that the group with 200 and fewer employees tended to consider these two practices as more important (mean ranks of 20.70 and 21.50 respectively) than the employee group with more than 200 employees with mean ranks of 15.39 and 14.23 respectively.

$H_0$: There is no difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the barriers of green logistics.

$H_1$: There is a difference between the two employee groups (< 200, 200 and above) with regard to their perception of the importance of each of the barriers of green logistics.

None of the barriers differ statistically significantly between the employee groups. Although not statistically significant, the mean ranks indicate that the small employee groups tended to consider the practices *lack of acceptance of advancement in new technology; poor organisational culture in GSCM; uncertainty and competition in market; lack of flexibility of suppliers to change towards GSCM; lack of green architects, consultants, green developers, contractors in the region; lack of training in GSCM; lack of sustainability certification like ISO14001 and lack of professional treatment and long term contracts for adopting GSCM from government* as slightly more important than the larger employee group.

### 6.3.5 Summary and findings of the cross-tabulations

In this section, a summary of the results of the cross-tabulations is provided. Cross-tabulations are used to determine whether there is a relationship between three variables, namely *company turnover* vs. *number of employees*, *company turnover vs. warehouses in square meters* and *company turnover vs. number of vehicles*.

- Table 5.33 illustrates that there is a positive relationship between company turnover and the number of employees. The higher a company's turnover per annum, the higher the number of employees employed by the logistics and transport companies.
- Table 5.34 illustrates that there is a positive relationship between company turnover and warehouses square meter. The higher a company's annual turnover, the bigger the warehouses in square meters that logistics and transport companies own.
- Table 5.35 illustrates that there is a positive relationship between *company turnover* and *number of vehicles*. The higher a company's annual turnover, the higher the number of vehicles that logistics and transport companies own.

### 6.3.6 Summary and findings of the best practice framework in green logistics and guidelines for SMEs and large companies to implement

In this section, a summary of the best practice framework in green logistics for logistics and transport companies in South Africa is discussed, followed by guidelines for large and small logistics and transport companies to be implemented according to their organisational structure, resources, finances and time available to them.

The framework was drafted to achieve the primary objective of the study, namely to develop a green logistics framework to assist logistics and transport companies in South Africa in sustaining the practice. Based on the results reported in Table 5.23, a draft of the framework was illustrated in Figure 5.24. The framework consisted of the following sections, namely *drivers of green logistics*, *best practices in green logistics management,* and *barriers of green logistics*. The *input* referred to the *drivers* of green logistics. These factors comprised the top five drivers rated by companies in Gauteng as the most important incentives or motivators for the implementation of green logistics practices. The drivers comprised *reducing logistics* *costs, differentiating from competitors, gaining a competitive advantage*, *rising cost of fuel* and *decreasing fuel bills.*

After companies have been motivated to implement green logistics practices, the implementation phase follows. This phase consists of the best practices in green logistics management and is divided into three sections, namely *bull's eye best practices, future transformers best practices and back burners* and *can-do best practices.* The *bull's eye* best practices are top priority for implementation. In the current study, best practices in the *bull's eye* quadrant were rated as very important and easy to implement. Large and small logistics and transport companies should strive to implement these practices. The *future transformers best practices* were second priority for implementation. These practices were rated as very important, but moderately to extremely difficult to implement. Large companies should strive to implement these practices, but SMEs should avoid these practices as they might be cost-intensive and require a lot of resources and time. The *can-do* and *back burners* best practices were last priorities as these practices were rated as less important and difficult to implement.

By implementing these practices, companies will achieve certain benefits. These benefits include *improving fuel efficiency, reducing emissions, establishing a competitive advantage, improving profits* and *enhancing CSR*. These benefits were rated as the top five reasons why companies in South Africa should implement green logistics practices. By implementing these practices, the output is achieved, namely the reduction of the negative impact on the environment.

Although there are various benefits for the implementation of green practices, companies also experience many barriers which prevent them from implementing these practices. These barriers were rated as the top five reasons why companies in South Africa struggle to implement green practices. The five barriers are:

- lack of knowledge and experience;
- lack of training in GSCM;
- lack of professional treatment and long-term contracts for adopting GSCM from government;
- lack of management initiatives for transport and logistics; and
- lack of top-level management commitment.

The best practice framework in Figure 5.24 can assist logistics and transport companies in South Africa in sustaining the practice.

Table 6.6 provides a summary of the guidelines for large companies to implement. These best practices lie in the *bull's eye* and *future transformers* quadrant.

**Table 6.6: A summary of the best practices in green logistics management for large companies to implement**

| **Recommended best practices in green logistics management for large companies to implement.** |
|---|
| **Changing truck fleets –** change of truck fleets and the standardisation of truck sizes promote the optimisation of freight and intermodal transportation. |
| **Creation of distribution centres –** creates an optimal solution for consolidating freight operations. |
| **Sustainable carrier selection –** selecting carriers that incorporate environmental practices in the services they provide. |
| **Installing an automatic warehousing system (AWS)** – this streamlines the processes within the warehouses, such as automatic storage and retrieval systems. |
| **Adapting facility design and construction/using a solar roof to save energy** – the layout and construction of warehouses directly influence the level of energy used. This includes installing **LED** lighting and fluorescent bulbs as well as more windows and fans for proper air circulation, and investing in motion sensor lighting. |
| **Conducting carbon footprint assessment –** companies can estimate the amount of $CO_2$ emissions generated by logistics activities by conducting a carbon footprint assessment. |
| **Adhering to green customer criteria gathering –** customers may decide to select logistics service providers if they conform to green standards and adhere to their "green criteria". |
| **Introducing and using tracking and tracing systems/satellite tracking/routing and load planning software –** implementing systems such as ERP and RFID to improve efficiency of daily operations. |
| **Environmental certifications –** companies should aim to receive an ISO14000 certificate by complying with environmental standards. |
| **Freight consolidation –** fewer trips are necessary by consolidating freight and less $CO_2$ emissions are produced. |
| **Selection of different equipment –** this entails selecting equipment that is environmentally friendly such as electric forklifts or installing alternative power sources such as APUs. |
| **Fuel efficiency and using fuel saving devices–** increasing the use of biofuel or cleaner diesel. |
| **Process optimisation and load optimisation/ double stacking –** increase the optimal usage of space during transport. |
| **Energy efficiency –** reducing the amount of energy generated by installing alternative energy power sources such as APUs and refrigerated trailers. |
| **Minimisation of inventories –** frequent trips can reduce the number of inventories stored. |
| **On-site recycling, packaging recycling, use of ecological materials –** to encourage more |

| Recommended best practices in green logistics management for large companies to implement. |
|---|
| environmentally friendly recycling.<br>**Publishing environmental footprint reports –** by publishing environmental footprint reports companies can attract new customers and clients, and gain new business contracts.<br>**Optimal routing planning –** management should reduce routes that are uneconomical and design routes that reduce distance, time and fuel.<br>**Moving a national DC operation to a regional DC operation and increase night-time deliveries –** by delivering freight at night faster turnaround times can be achieved due to less traffic congestion and road works.<br>**Reducing packaging and using different packaging technologies and material to reduce contamination –** eco-friendly materials can be used to make recycling more efficient.<br>**Developing relationships/communication –** these relationships can be formed between suppliers and buyers or customers and involve contracts or alliances.<br>**More frequent deliveries –** regular deliveries of small quantities can reduce $CO_2$ emissions.<br>**Distribution consolidation –** freights should be consolidated to reduce the number of trips and loading and unloading times on site.<br>**Multimodal transport and services –** making use of multimodal services to reduce carbon emissions by combining more environmental modes of transport, e.g. road to rail then to road again.<br>**Developing a strategic environmental plan –** management should include environmental management in their business strategy.<br>**Implementing an EMS, IMS and installing fleet management systems –** these systems could be implemented to streamline and integrate environmental goals in business activities or outputs.<br>**Transport collaboration/ Telematics –** to reduce the amount of carbon emissions generated and externalities such as air pollution and noise.<br>**Palletisation of cargo/Pallet and container pooling systems –** companies should aim to purchase reusable/recyclable pallet systems.<br>**Modal choice –** use environmentally friendly modes of transport such as railway transport and transporting less freight by road.<br>**Reconditioning and reusing pallets and containers –** purchase plastic pallets that can be recycled easier than wooden pallets.<br>**Disposing of products –** this entails on-site recycling by making use of "green packaging" or "ecological packaging" for more efficient recycling.<br>**Using clean vehicles and installing new washing facilities–** purchasing hybrid and electric vehicles and increasing fuel efficiency to reduce oil usage. Rainwater can be used to clean vehicles.<br>**Selecting clean material handling equipment -** choosing more sustainable handling equipment such as electric forklifts instead of diesel forklifts, or operating equipment on biofuel.<br>**Euro IV lubricating oils** – this is subject to availability in certain regions.<br>**Monitoring fuel consumption –** trucks can be preset to switch off if they idle too long and waste fuel.<br>**Providing driver training-**fuel-saving tips for drivers and fuel management for transport operators. |

| Recommended best practices in green logistics management for large companies to implement. |
|---|
| **Reducing engine idling –** if a truck idles too long fuel is wasted and carbon emissions increased. Preset trucks to switch off when they idle too long. Provide driver training on engine idling. |
| **Bonus system to encourage drivers to drive safely and fuel-efficiently –** the bonus system can consist of rebates or monetary incentives. |
| **Monitoring fuel consumption –** by installing fuel monitoring equipment. |
| **Creating safety manuals –** this is specifically aimed at truck drivers. |
| **Promoting environmental awareness among managers –** managers should attend workshops and environmental training initiatives to acquire the necessary knowledge about the environmental impact of their daily operations, and to educate their employees. |
| **Providing incentives for green behaviour practices –** this can be in the form of rebates or monetary incentives. |
| **Publishing environmental efforts reports – t**his can enhance a company's green credentials and attract new customers. Environmental reports can improve companies' corporate image. |
| **Developing a formal environmental sustainability statement –** this can improve corporate social responsibility (CSR). |

Table 6.7 on the next page provides a summary of the guidelines for SMEs to implement. These best practices lie in the *bull's eye* quadrant and were rated as very important and easy to implement.

**Table 6.7: A summary of the best practices in green logistics management for SMEs to implement**

| Recommended best practices in green logistics management for SME to implement |
|---|
| **Modal choice –** SMEs should aim to select more environmental and cost-friendly modes, such as railway transportation, or a combination of rail and road transport (multimodal transport). |
| **Reconditioning and reuse of pallets and containers** – SMEs should purchase plastic pallets instead of wooden pallets for easier recycling. |
| **Disposing of products –** this entails on-site recycling, make use of 'green packaging' or 'ecological packaging' for more efficient recycling. |
| **Palletisation of cargo and container pooling systems** – SMEs should aim to purchase reusable/recyclable pallet systems. Plastic pallets are more suitable for recycling than wooden pallets. Container pooling systems should be inspected and recycled on site, and not transported to another depot for inspection. This can reduce fuel consumption. |
| **Using clean vehicles** – this entails purchasing hybrid and electric vehicles and increasing fuel efficiency to reduce oil usage. |
| **Selecting clean material handling equipment** – choose more sustainable handling equipment such as electric forklifts, or operate equipment on biofuel (when available in SA). |
| **Euro IV lubricating oils –** this is subject to availability in certain regions. |
| **Monitoring fuel consumption** – by installing fuel monitoring equipment. |
| **Reducing engine idling –** when a truck idles too long fuel is wasted and carbon emissions increased. Preset trucks to switch off when they idle too long. Provide driver training on engine idling. |
| **Providing driver training and fuel-saving tips for drivers** – managers of SMEs should initiate regular training workshops for drivers on a monthly basis on how to save fuel. |
| **Bonus system to encourage drivers to drive safely and fuel-efficiently** – the bonus system can be in the form of rebates or monetary value. |
| **Creating safety manuals** – this is specifically aimed at truck drivers. |
| **Promoting environmental awareness among managers** – managers of SMEs should attend workshops and environmental training initiatives to acquire the necessary knowledge about the environmental impact of their daily operations, and to educate their employees. |
| **Providing incentives for green behaviour practices** – this can be in the form of rebates or monetary incentives. Managers can encourage personnel to implement green activities by incorporating environmental scores in their performance agreement. |
| **Publishing environmental efforts reports** – this can enhance SMEs' green credentials and attract new customers and business contracts. Environmental reports can improve SMEs' corporate image and give them a competitive edge. |
| **Developing a formal environmental sustainability statement** – this can improve SMEs' CSR. |
| **Communication**- SMEs should form relationships through communication with suppliers. |
| **Double stacking**- increase the optimal usage of space during transport. |

## 6.4 RECOMMENDATIONS FOR THE MANAGEMENT OF LOGISTICS COMPANIES

Based on a comprehensive literature review and empirical study with regard to green logistics, the following recommendations are made;

Logistics and transport companies should:

- familiarise themselves with the concept of green logistics regardless of their size;
- align environmental initiatives with the strategic goals of the company, proper planning is crucial for the implementation of green practices;
- conduct a feasibility study and determine how costly it will be to implement particular practices. Certain practices require more capital, time and resources to implement than others;
- consider the following factors when striving to implement green logistics practices: financial resources, organisational structure, management style, human resources and available technology;
- strive to implement green logistics strategies to reduce carbon emissions and in doing so adhere to future government regulations of carbon taxes; and
- implement green logistics practices to gain a competitive advantage over those companies who don’t strive to implement green practices.

The management of logistics and transport companies should:

- consider a modal shift from road to rail to reduce carbon emissions;
- attend various training initiatives and workshops regarding green logistics in order to establish a culture of environmental awareness within the company;
- educate staff members about the benefits of implementing environmental practices; and
- use the framework and guidelines provided to implement green logistics practices in order to achieve sustainability.

In Tables 6.6 and 6.7, specific recommendations have been made for the different sizes of logistics and transport companies.

## 6.5 FUTURE RESEARCH

The future research possibilities include the following:

- The recommended best practices for implementation as outlined in the best practice framework can be tested on SMEs and large companies in the logistics industry.
- A refined best practice framework can be compiled after the various practices have been tested on large companies and SMEs and feedback provided on which practices should be left out. Thereafter more industry-specific guidelines could be drafted again for implementation.
- Green logistics activities of other transport modes can be investigated such as rail, air and sea transport.
- This framework can be applied to emerging markets in other countries, to establish whether the best practices apply to all emerging markets, or specifically to South Africa.
- Future studies could focus specifically on educating SMEs on the environment and the transformation process towards more sustainable businesses.
- For future research, a larger sample could be used to deliver more statistically significant results and to determine the reliability of the results.

## 6.6 CONCLUSION

The current research study confirmed the importance of green logistics practices in the daily operating activities of various logistics and transport companies in South Africa, and the impact on the environment. Companies should strive to achieve sustainability to be able to benefit from implementing green logistics practices. Some of the benefits are: improved profits and fuel efficiency, reduced emissions and logistics costs as well as satisfying customer requirements and achieving a competitive advantage. Although this study confirmed that 78% of logistics and transport companies were aware of green logistics, very few companies are actively implementing these practices. The main reasons for not implementing these practices are related to a lack of training, knowledge and experience in GSCM, a lack of commitment by top management and a lack of management initiatives for transport and logistics. The results of the study revealed that there was a significant difference between SMEs (<200) and large (200 and above) companies with regard to their importance rating on green logistics practices.

The primary objective of the study was achieved, and a framework in green logistics was drafted to assist logistics and transport companies in South Africa in sustaining the practice. Based on the literature findings, all the best practices identified in literature showed to be important in practice. Management of SMEs and large logistics and transport companies could use the framework to determine which green logistics practices are possible for them to implement with regard to the resources, capital and time available to them. Guidelines were drafted for large companies and SMEs to assist them in sustaining the practice.

A significant academic research gap in South Africa exists regarding the concept of green logistics. The current study aimed to contribute to the academic research field in green logistics in South Africa and to expose companies in the logistics industry, especially SMEs, to the concept of green logistics by developing a framework around green logistics which large companies and SMEs could use and implement in their businesses. Furthermore, creating opportunities for future research in green logistics for both practitioners in the academia and corporate environments.

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## Appendix A: Participant information sheet

**PARTICIPANT INFORMATION SHEET**

09 September 2014

GREEN LOGISTICS QUESTIONNAIRE FOR SELECTED COMPANIES IN SOUTH AFRICA

**Dear Prospective Respondent**

I am Suzanne Jansen van Rensburg, a lecturer in the Department of Transport Economics, Logistics and Tourism at the University of South Africa (Unisa). I am inviting you to participate in a survey entitled **Green logistics questionnaire for selected companies in South Africa.**

The aim of this study is to design a framework in green logistics practices for selected logistics and transport companies in South Africa, and to determine how these can be adopted for small and medium enterprises in the country. The questionnaire is structured to determine the benefits, drivers and barriers of implementing green logistics practices, and to explore the green logistics practices selected companies are currently implementing. By participating in the survey, you are not only making a valuable contribution to green logistics research in South Africa, but you are also contributing to the effort of saving the environment and assisting in creating jobs in a green environment. The reason for your selection is linked to your engagement in logistics or transport activities in Gauteng.

Your contribution to the study involves completing a questionnaire, which will take approximately 20 minutes of your time. Clear instructions are provided at the top of each section to assist you to complete the questionnaire. Please note, participation is **voluntary and your response will be kept strictly confidential and anonymous.** There is no penalty or loss of benefit for non-participation. You are free to withdraw at any time and without giving a reason, although once the questionnaire has been submitted it will not be possible to withdraw. The researcher will have access to the computer-based records stored on a password-protected computer. Records will be retained for a period of five years; thereafter they will be permanently disposed of.

This study has received written approval from the Research Ethics Committee of the College of Economic and Management Sciences at Unisa. A copy of the approval letter can be obtained from the researcher if you so wish. If you would like to be informed of the final research findings or should you require any further information, please contact Suzanne Jansen van Rensburg on 012 433 4606.

Thank you for taking the time to read this information sheet and for participating in this study.

Suzanne Jansen van Rensburg

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**1. CONSENT TO PARTICIPATE IN THIS STUDY**

- I confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.
- I have read (or had explained to me) and understood the purpose of the study as explained in the information sheet.
- I have had sufficient opportunity to ask questions and am prepared to participate in the study.
- I understand that my participation is voluntary, and that I am free to withdraw at any time without penalty (if applicable).
- I am aware that the findings of this study will be anonymously processed into a research report, journal publications and/or conference proceedings.
- I agree to the recording of the survey.
- I have received a signed copy of the informed consent agreement.

**I understand and accept the above.**

Please choose **only one** of the following:

☐ Yes

☐ No

## Appendix B: Questionnaire

UNISA university of south africa

**GREEN LOGISTICS QUESTIONNAIRE FOR SELECTED COMPANIES IN SOUTH AFRICA**

**Dear Prospective Respondent**

I am Suzanne Jansen van Rensburg, a lecturer in the Department of Transport Economics, Logistics and Tourism at the University of South Africa (Unisa). I am inviting you to participate in a survey entitled **Green logistics questionnaire for selected companies in South Africa.**

The aim of this study is to design a framework for green logistics practices applicable to logistics and transport companies in South Africa, and to determine how these can be adopted for small and medium enterprises in the country. The questionnaire is structured to determine the benefits, drivers and barriers of implementing green logistics practices, and to explore the green logistics practices selected companies are currently implementing. By participating in the survey, you are not only making a valuable contribution to green logistics research in South Africa, but you are also contributing to the effort of saving the environment and assisting in creating jobs in a green environment. The reason for your selection is linked to your engagement in logistics or transport activities in Gauteng.

Your contribution to the study involves completing a questionnaire, which will take approximately 20 minutes of your time. Clear instructions are provided at the top of each section to assist you to complete the questionnaire. Please note, participation is **voluntary and your response will be kept strictly confidential and anonymous.** There is no penalty or loss of benefit for non-participation. You are free to withdraw at any time and without giving a reason, although once the questionnaire has been submitted it will not be possible to withdraw. The researcher will have access to the computer-based records stored on a password-protected computer. Records will be retained for a period of five years; thereafter they will be permanently disposed of.

This study has received written approval from the Research Ethics Committee of the College of Economic and Management Sciences at Unisa. A copy of the approval letter can be obtained from the researcher if you so wish. If you would like to be informed of the final research findings or should you require any further information, please contact Suzanne Jansen van Rensburg on 012 433 4606.

Thank you for taking the time to read this information sheet and for participating in this study. Click on the **next** button at the bottom of this page to commence your response.

Suzanne Jansen van Rensburg

Exit and clear survey | Load unfinished survey | Next

UNISA university of south africa

**GREEN LOGISTICS QUESTIONNAIRE FOR SELECTED COMPANIES IN SOUTH AFRICA**

0%

100%

**CONSENT TO PARTICIPATE IN THIS STUDY**

*

I confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the purpose of the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary, and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be anonymously processed into a research report, journal publications and/or conference proceedings.

I agree to the recording of the survey.

I have received the informed consent agreement.

**I understand and accept the above.**

○ Yes ○ No

Exit and clear survey | Resume later | Next

UNISA university of south africa

GREEN LOGISTICS QUESTIONNAIRE FOR SELECTED COMPANIES IN SOUTH AFRICA

0%

100%

## SECTION A- GENERAL INFORMATION

*Position
*Choose one of the following answers*

- ○ Lower level management
- ◉ Middle level management
- ○ Top level management

*Company turnover per annum
*Choose one of the following answers*

- ○ Less than R10 million
- ◉ R10 million - R100 million
- ○ R101 - R150 million
- ○ R151 -R500 million
- ○ R500+ million
- ○ Unsure

*Number of employees in your company
*Choose one of the following answers*

- ○ Less than 100
- ○ 100-200
- ◉ 201-1000
- ○ 1 001-10 000
- ○ 10 000+
- ○ Unsure

*Fleet (number of vehicles) in your company
*Choose one of the following answers*

- ○ Less than 10
- ○ 10 - 100
- ○ 101 - 1000
- ◉ 1001 - 10 000
- ○ 10 000+
- ○ Unsure

*Warehouses m$^2$
*Choose one of the following answers*

- ○ Less than 10 000 m2
- ○ 10 000-20 000 m2
- ◉ 20 001-30 000 m2
- ○ 30 001-40 000 m2
- ○ 40 000 + m2
- ○ Unsure

*Which option describes the status of the company you work for best?
*Choose one of the following answers*

- ○ Head office
- ○ Holding company
- ◉ Branch
- ○ Subsidiary
- ○ Independent unit
- ○ Other:

*Are you aware of the concept "green logistics"?

◉ Yes ○ No

Exit and clear survey | Resume later | Next

UNISA university of south africa

**GREEN LOGISTICS QUESTIONNAIRE FOR SELECTED COMPANIES IN SOUTH AFRICA**

0%

100%

## SECTION B- DRIVERS, BENEFITS AND BARRIERS OF GREEN LOGISTICS

The drivers of green logistics are the factors that motivate or promote the implementation of green logistics practices.

The benefits of green logistics are the advantages or rewards gained from implementing green logistics practices.

The barriers of green logistics are the difficulties or obstacles preventing companies from implementing green logistics practices.

On a scale from 1 to 5, please rate the importance of each driver using the rating scale below:

**Guide for the 5-point scale:**

1=not important at all

2=of little importance

3=somewhat important

4=very important

5=extremely important

If none of the above is applicable, please tick the **not applicable** column.

*__Drivers of implementing green logistics practices__

| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable |
|---|---|---|---|---|---|---|
| Improving public relations | ○ | ● | ○ | ○ | ○ | ○ |
| Improving customer relations | ○ | ○ | ● | ○ | ○ | ○ |
| Financial Return On Investment (ROI) | ○ | ○ | ○ | ● | ○ | ○ |
| Part of corporate social responsibility | ○ | ○ | ● | ○ | ○ | ○ |
| Decreasing fuel bills | ○ | ○ | ○ | ● | ○ | ○ |
| Increasing supply chain efficiency | ○ | ○ | ○ | ● | ○ | ○ |
| Gaining competitive advantage | ○ | ● | ○ | ○ | ○ | ○ |
| Desire to be thought leader in sustainability | ○ | ● | ○ | ○ | ○ | ○ |
| Compliance with government regulations | ○ | ○ | ○ | ● | ○ | ○ |
| Rising cost of transportation | ○ | ○ | ● | ○ | ○ | ○ |
| Improve corporate image | ○ | ○ | ○ | ○ | ● | ○ |
| Satisfy customer requirements | ○ | ○ | ○ | ● | ○ | ○ |
| Decreasing risk | ○ | ● | ○ | ○ | ○ | ○ |
| Improving investor relations | ○ | ○ | ○ | ● | ○ | ○ |
| Rising cost of fuel | ○ | ○ | ● | ○ | ○ | ○ |
| Optimising logistics flow | ○ | ○ | ○ | ○ | ● | ○ |
| Reducing logistics costs | ○ | ○ | ○ | ● | ○ | ○ |
| Differentiation from competitors | ○ | ○ | ● | ○ | ○ | ○ |
| Establishing alternative networks | ○ | ● | ○ | ○ | ○ | ○ |

***Benefits of implementing green logistics practices**

| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable |
|---|---|---|---|---|---|---|
| Improve brand image | ● | ○ | ○ | ○ | ○ | ○ |
| Satisfy customer requirements | ○ | ○ | ● | ○ | ○ | ○ |
| Differentiate from competitors | ○ | ○ | ○ | ○ | ○ | ○ |
| Reduce overall business costs | ○ | ○ | ○ | ● | ○ | ○ |
| Enhance corporate social responsibility | ○ | ○ | ● | ○ | ○ | ○ |
| Improve profits | ○ | ● | ○ | ○ | ○ | ○ |
| Establish a competitive advantage | ○ | ○ | ○ | ● | ○ | ○ |
| Reduce waste/improve disposal | ○ | ○ | ● | ○ | ○ | ○ |
| Optimise logistics flow | ○ | ● | ○ | ○ | ○ | ○ |
| Expand to new markets | ○ | ○ | ● | ○ | ○ | ○ |
| Reduce emissions | ○ | ○ | ○ | ● | ○ | ○ |
| Developing new products | ○ | ○ | ○ | ○ | ● | ○ |
| Winning new customers | ○ | ○ | ○ | ● | ○ | ○ |
| Reduce logistics costs | ○ | ○ | ● | ○ | ○ | ○ |
| Optimise manufacturing | ○ | ● | ○ | ○ | ○ | ○ |
| Reduce manufacturing costs | ○ | ○ | ○ | ● | ○ | ○ |
| Improve visibility of green supply chain drivers | ○ | ○ | ○ | ● | ○ | ○ |
| Increase use of recyclables | ○ | ○ | ○ | ○ | ● | ○ |
| Improve fuel efficiency | ○ | ○ | ○ | ○ | ● | ○ |
| Reduce use of toxic materials | ○ | ● | ○ | ○ | ○ | ○ |
| Improve employee satisfaction | ○ | ● | ○ | ○ | ○ | ○ |

***Barriers of implementing green logistics practices**

| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable |
|---|---|---|---|---|---|---|
| Lack of Integration Technology systems | ● | ○ | ○ | ○ | ○ | ○ |
| Lack of acceptance of advancement in new technology | ○ | ● | ○ | ○ | ○ | ○ |
| Poor organisational culture in Green Supply Chain Management (GSCM) | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of skilled human resource professionals in sustainability and GSCM | ○ | ○ | ○ | ● | ○ | ○ |
| Uncertainty and competition in market | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of government incentive system for GSCM practitioners | ○ | ● | ○ | ○ | ○ | ○ |
| Poor implementation of green practices within a supply chain | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of top level management commitment | ○ | ○ | ○ | ○ | ● | ○ |
| Cost of implementation for GSCM | ○ | ○ | ○ | ● | ○ | ○ |
| Lack of flexibility of suppliers to change towards GSCM | ○ | ○ | ● | ○ | ○ | ○ |
| Customer's unawareness towards GSCM products and services | ○ | ● | ○ | ○ | ○ | ○ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lack of knowledge and experience | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of green architects, consultants, green developers, contractors in the region | ○ | ○ | ○ | ● | ○ | ○ |
| Lack of training in GSCM | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of internal sustainability audits within the organisation | ○ | ● | ○ | ○ | ○ | ○ |
| Lack of external sustainability audits for suppliers and contractors | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of sustainability certification like ISO 14001 | ○ | ○ | ○ | ● | ○ | ○ |
| Lack of professional treatment and long term contracts for adopting GSCM from government | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of management initiatives for transport and logistics | ○ | ○ | ● | ○ | ○ | ○ |
| Lack of energy management and waste management of the organization | ○ | ○ | ● | ○ | ○ | ○ |

Exit and clear survey     Resume later     Next

**GREEN LOGISTICS QUESTIONNAIRE FOR SELECTED COMPANIES IN SOUTH AFRICA**

0%

100%

## Section C- BEST PRACTICES IN GREEN LOGISTICS MANAGEMENT

**Please rate/indicate**

(a) the **importance** of the following best practices on a scale of 1-5.

(b) the **difficulty** of implementing these practices. Use the guide indicated below to decide how difficult it is/ will be to implement the practise.

Please use the rating scales provided for the statements below:

**Guide for the 5-point importance scale;**

1=not important at all

2=little important

3=somewhat important

4=very important

5=extremely important

**Guide for the 5-point difficulty of implementation scale;**

Difficulty of implementation:

1. Very easy to implement, few resources needed, little time or complexity
2. Easy to implement, some resources and time needed
3. Moderately difficult to implement, moderate complexity, can be remediated with moderate resources and time
4. Very difficult to implement, resources and time required and is most likely complex
5. Extremely difficult to implement, high impact on resources and time, very complex

***Strategic best practices relating to your company**

| | Importance of implementing the practice | | | | | | | Difficulty to implement these practices | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable | | Very easy (1) | 2 | 3 | 4 | Extremely difficult (5) | Not applicable |
| Change of truck fleets | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ● | ○ | ○ | ○ | ○ |
| Standardisation of truck sizes | ○ | ○ | ○ | ● | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |
| Creation of distribution centres | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ● | ○ | ○ | ○ | ○ |
| Sustainable carrier selection | ○ | ○ | ○ | ● | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |
| Automatic Warehousing Systems (AWS) | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Facility design and construction | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |
| Carbon footprint assessment | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Green customer criteria gathering | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Introduction of tracking and tracing systems | ○ | ○ | ○ | ● | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |

***Tactical best practices relating to your company**

| | Importance of implementing the practice | | | | | | | Difficulty to implement these practices | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable | | Very easy (1) | 2 | 3 | 4 | Extremely difficult (5) | Not applicable |
| Palletisation of cargo | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |
| Freight consolidation | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ● | ○ | ○ | ○ | ○ |
| Modal choice | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |
| Selection of different equipment | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Reconditioning and reuse of pallets and containers | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ● | ○ |
| Disposition of products | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Environmental certifications | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Pallet and container pooling systems | ○ | ● | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ● | ○ | ○ |
| Use of different packaging technologies and materials to reduce contamination | ○ | ○ | ● | ○ | ○ | ○ | | ○ | ○ | ● | ○ | ○ | ○ |

***Operational best practices relating to your company**

| | Importance of implementing the practice | | | | | | Difficulty to implement these practices | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable | Very easy (1) | 2 | 3 | 4 | Extremely difficult (5) | Not applicable |
| Use of clean vehicles. | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Fuel efficiency | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Load optimisation | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Clean material handling equipment | ○ | ○ | ○ | ● | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ |
| Energy efficiency | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Process optimisation | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Minimization of inventories | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| On-site recycling, packaging recycling, use of ecological materials | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ |
| Environmental footprint reports | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ |
| Use of tracking and tracing systems to improve operations performance | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Carbon footprint assessment | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |

***Organisational best practices relating to your company**

| | Importance of implementing the practice | | | | | | Difficulty to implement these practices | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable | Very easy (1) | 2 | 3 | 4 | Extremely difficult (5) | Not applicable |
| Optimal routing planning | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Double stacking | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Moving a national Distribution Center (DC) operation to a regional DC operation | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Night time deliveries | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Optimising load fill | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Reducing packaging | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Developing relationships | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| More frequent deliveries | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Distribution consolidation | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Multi-modal services: e.g. road to rail then to road again | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Development of a strategic environmental plan | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Implementation of an Environmental Management System (EMS) | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Integrated Management Systems (IMS) | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |

| | Importance 1 | 2 | 3 | 4 | 5 | Not applicable | Difficulty 1 | 2 | 3 | 4 | 5 | Not applicable |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Communication | | | | | ● | | | | | | ● | |
| Transport collaboration | | | | ● | | | | | | | ● | |
| Fuel management for transport operators Training of drivers , new technology | | | | | ● | | | | | | ● | |

***Technical best practices relating to your company**

| | Importance of implementing the practice | | | | | | Difficulty to implement these practices | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable | Very easy (1) | 2 | 3 | 4 | Extremely difficult (5) | Not applicable |
| Installing fleet management systems | | | | | | ● | | | ● | | | |
| Telematics | | | ● | | | | | | ● | | | |
| Using fuel saving devices | | | ● | | | | | | ● | | | |
| Euro IV lubricating oils | | | ● | | | | | | ● | | | |
| Installing new washing facilities (modern washing facilities) | | | ● | | | | | | ● | | | |
| Use of double-deck trailer to replace single deck trailers | | | | | ● | | | | ● | | | |
| Use of multi-modal transport | | | | ● | | | | | | ● | | |
| Monitoring fuel consumption | | ● | | | | | | | | ● | | |
| Use of rainwater for vehicle cleaning | | | | | ● | | | | | ● | | |
| Exchanging diesel vehicles with electric vehicles | | | | | ● | | | | | ● | | |
| Satellite tracking | | | | ● | | | | | | ● | | |
| Load optimisation | | ● | | | | | | | | | | |
| Installing routing software | | | | | ● | | | | ● | | | |
| Electric forklift trucks instead of diesel | | | | ● | | | | | ● | | | |
| Installing software to reduce to measure , monitor and reduce fuel consumption | | | ● | | | | | | ● | | | |
| Load planning software | | | ● | | | | | | ● | | | |
| Solar roof to save energy | | | ● | | | | | ● | | | | |

***Internal best practices relating to your company**

| | Importance of implementing the practice | | | | | | Difficulty to implement these practices | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not important at all (1) | 2 | 3 | 4 | Extremely important (5) | Not applicable | Very easy (1) | 2 | 3 | 4 | Extremely difficult (5) | Not applicable |
| Fuel saving tips for drivers | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Reducing engine idling | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Driver training | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Bonus system to encourage drivers to drive safely and fuel efficiently | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Monitoring fuel consumption by installing fuel monitoring equipment | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Creating safety manuals | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Promote environmental awareness among managers | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Provide incentives for green behaviour practices | ○ | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |
| Publish environmental efforts reports | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ | ○ |
| Develop a formal environmental sustainability statement | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ | ● | ○ | ○ |

Additional comments:

Exit and clear survey | Resume later | Submit

Thank you!
Your responses have been recorded.

## Appendix C: Ethical clearance certificate

UNISA university of south africa

27 May 2014

**Ref #: 2014_CEMS_SES_005**

**SCHOOL OF ECONOMIC SCIENCES**
**RESEARCH ETHICS REVIEW COMMITTEE**

This is to certify that the application for ethics clearance submitted by

Mrs Suzanne Louise Jansen van Rensburg (staff # 90185129, braaksl@unisa.ac.za)

A Framework in green logistics for selected SME's in South Africa **received <u>Ethics Approval</u>**

The revised application for ethics clearance for the above mentioned research was reviewed by the School of Economic Sciences on 22 July 2014 in compliance with the Unisa Policy on Research Ethics. Ethical Clearance is granted.

You may proceed with the research project on condition that all participants are provided with Informed Consent forms prior to any fieldwork. Participation is strictly voluntary. The research ethics principles outlined by the Unisa Policy on Research Ethics must be adhered to throughout the project. Please be advised that the committee needs to be informed should any part of the research methodology as outlined in the Ethics application (Ref # 2014_CEMS_SES_005) change in any way or in case of adverse events. This certificate is valid for the duration of the project. The SES Research Ethics Review Committee wishes you all the best with this research undertaking.

Kind regards,

Loedolff

**Ms C Loedolff**
**Chairperson of SES, CEMS, UNISA**

**Prof VA Clapper**
**Executive Dean: CEMS**

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
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Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
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Open Rubric

## Appendix D: List of companies contacted

| Name of company | Email address | Location |
|---|---|---|
| A C CARRIERS | mtrucker@iafrica.com | Sandton |
| A JOHAN'S TRANSPORT AND WAREHOUSING | ajohan@iafrica.com | Johannesburg |
| AARON & SON TRANSPORT LOGISTICS | ankunene@hotmail.com | Johannesburg |
| ABNORMAL LOAD | andrieso@gpg.gov.za | Boksburg |
| ACCESS | bruce.magor@access.co.za | Johannesburg |
| AERO TRUCK | sales@aerotruck.co.za | Alberton |
| AFMEX CARGO | smuanza@afmexcargo.co.za | Johannesburg |
| AFRICAN CARGO MANAGEMENT | mathew@africancargo.co.za | Boksburg |
| AFRICAN HUMAN LOGISTICS | info@africanhl.co.za | Centurion |
| AIR BUSINESS LOGISTICS PTY LTD | info@airbusiness.co.za | Germiston |
| APC STORAGE SOLUTIONS SOUTH AFRICA | websales@apcgroup.co.za | Isando |
| A-PRO LOGISTICS PTY LTD | alta@anorel.co.za | Centurion |
| ARAMEX | Oluwatoyin.Osundiran@aramex.com | Johannesburg |
| ASPEN LOGISTICS SERVICES | shoba@aspenlog.co.za | Bedfordview |
| ATEX SPECIALISED PROJECT SOLUTIONS | Jack@atex.co.za | Sandton |
| ATRAX LOGISTICS SA PTY Ltd | dewald@atrax.za.com | Kempton Park |
| BAKERS TRANSPORT PTY LTD | marketing@bakerstransport.co.za | Alberton |
| BARLOWORLD LOGISTICS AFRICA | ldewet@bwlog.com | Sandton |
| BB TRANSPORT | marketing@bbtransport.co.za | Johannesburg |
| BELL TRUCKING | gart@belltrucking.co.za | Johannesburg |
| BERCO EXPRESS PTY LIMITED | csdvaal@bercoexpress.co.za | Vanderbijlpark |
| BERTLING | uwe.niederheitmann@bertling.com | Johannesburg |
| BEYOND AFRICA LOGISTICS CONSULTANTS | michelle@beyondafricalogistics.com | Parktown |
| BHOJA EXPRESS CC | info@bhojaexpress.co.za | Benoni |
| BIDVEST PANALPINA LOGISTICS (BPL) | marcuse@bpl.za.com | Johannesburg |
| BOWLINE FULFILMENT (PTY) LTD | infojhb@bowline.co.za | Midrand |
| BRINKS SA PTY LTD | info.fa@brinksinc.com | Kempton Park |
| BRUNO COURRIER HOLDINGS | michelle@brunocouriers.com | Kempton Park |
| CARGILL LOGISTICS | melissa_blake@cargill.com | Johannesburg |
| CARGO CARRIERS | marketing@cargocarriers.co.za | Johannesburg |
| CC LOGISTICS | cliff@cclogistics.co.za | Centurion |
| CEVA LOGISTICS | Natasha.colyn@cevalogistics.com | Pomona |

| **Name of company** | **Email address** | **Location** |
|---|---|---|
| CHEP South Africa Pty Ltd | robin.stewart@chep.com | Johannesburg |
| ClOVER LOGISTICS | logistics@clover.co.za | Roodepoort |
| CMH FLEET SOLUTIONS | niel.behrens@mpsa.com | Midrand |
| COLLABORATIVE XCHANGE | grant.marshbank@cxchange.co.za | Sandton |
| CONCORDE EXPRESS PTY LTD | info@concordeexpress.co.za | Pretoria |
| CROSS SA | warren.ocd@gmail.com | Parklands |
| CROSSROADS DISTRIBUTION | kenl@crossroads.co.za | Kempton Park |
| CROSSWISE GROUP | info@crosswisegroup.co.za | Germiston |
| DB SCHENKER | indrin.moodley@schenker.co.za | Kempton Park |
| DIGISTICS | webmaster@digistics.co.za | Edenvale |
| DOVETAIL | yolandib@dovetail.co.za | Bryanston |
| E-DEK | roland@edek.co.za, felix@edek.co.za | Randburg |
| ENKAY LOGISTICS | info@enkaylogistics.co.za | Centurion |
| EQSTRA FLEXI FLEET | charding@flexifleet.co.za | Germiston |
| ERGON LOGISTIC PTY LTD | johan@ergonlogistics.co.za | Vanderbijlpark |
| EXPOLANKA FREIGHT PTY LTD | ops@expolankasouthafrica.com | Kempton Park |
| FALCON GATE LOGISTICS | john@falcongate.co.za | Boksburg |
| FLEET AND FUELMANAGEMENT SERVICES | sales@ffms.co.za | Vanderbijlpark |
| FOURPL GROUP | bpearson@fourpl.com | Centurion |
| FREIGHT SA | info@freightsa.co.za | Johannesburg |
| FREIGHT STAR | infojhb@freightstar.co.za | Johannesburg |
| G A C LASER INTERNATIONAL LOGISTICS PTY LTD | reception.pta@gaclaser.co.za | Isando |
| GARDEE GLOBAL | muhammad@gardeeglobal.co.za | Johannesburg |
| GARVEST AFRICA PTY LTD | info@garvestafrica.com | Midrand |
| GENESIS LOGISTICS | genlog@global.co.za | Alberton |
| GO TRANS FREIGHT SERVICES PTY LTD | stephen@gotrans.co.za | Boksburg |
| GOODS IN TRANSIT | vishnu@gitlogistics.co.za | Pomona |
| GOV LOGISTICS COURIERS PTY LTD | kagisodhladhla@telkomsa.net | Boksburg |
| GREATER THEN WAREHOUSING & LOGISTICS | piet.cilliers@gtwls.co.za | Vanderbijlpark |
| GRINROD Logistics | grindrod@grindrod.co.za | Johannesburg |
| HANSAIR LOGISTICS PTY LTD | sales@hansairlogistics.co.za | Germiston |
| HELLMANN WORLDWIDE LOGISTICS PTY LTD | vnunco@za.hellmann.net | Kempton Park |
| Heritage transport | heritage.g@mweb.co.za | Krugersdorp North |
| HESTONY TRANSPORT | etuan@hestony.co.za | Johannesburg |

| Name of company | Email address | Location |
|---|---|---|
| IJM EXPRESS FREIGHT AND LOGISTICS CC | laureen@ijmexpress.co.za | Germiston |
| IMPERIAL CARGO PTY LTD | epetersen@imperialcargo.co.za | Alberton |
| IMPERIAL LOGISTICS | reetsangm@imperial.co.za | Boksburg |
| IMPERIAL RETAIL LOGISTICS | fspies@imperial.co.za | Germiston |
| IMPERIAL THE COLD CHAIN | ldutoit@imperial.co.za | Midrand |
| IMPSON LOGISTICS PTY LTD | sam.dhlamini@impson.co.za | Boksburg |
| IN-HOUSE CROWN LOGISTICS | craigs@inhousecrown.co.za | Edenvale |
| INTERCONNECT LOGISTICS | walterv@interconnectl.co.za | Kempton Park |
| KAPELE FREIGHT AND LOGISTICS SERVICES PTY LTD | gideonb@kapele.co.za | Kempton Park |
| KATLEGO GLOBAL LOGISTICS PTY LTD | mosesm@katlegoint.co.za | Midrand |
| KGB SHORTHAULS | markh@kgb.co.za | Vanderbijlpark |
| KODAV LOGISTIC SOLUTIONS | ottog@kodav.co.za | Randburg |
| KUEHNE AND NAGEL (PTY) LTD | gordon.wyatt@kuehne-nagel.co.za | Johannesburg |
| KWS CARRIERS | info@kwscarriers.co.za | Vereeniging |
| LANGALAMIBRAND LOGISTICS | jabezleonardo@webmail.co.za | Braamfontein |
| LERUMO LOGISTICS | carinag@lerumo.co.za | Centurion |
| LOCHHEAD WHITE AND WOMERSLEY (PTY) LTD | logistics@jhb.lwwfreight.co.za | Germiston |
| LOGISTIC TECHNOLOGIES | reception@sigmalog.co.za | Johannesburg |
| LOGISTIC TECHNOLOGY SOLUTIONS | info@ltsconsulting.com | Johannesburg |
| LOGISTICOR CC/ Ziegler SA | sideney_delemos@ziegler-za.com | Meadowdale |
| LOGISTICS 365 | brian@logistics365.co.za | Johannesburg |
| LOGWIN AIR & OCEAN SA (PTY) LTD | patrick.federle@logwin-logistics.com | Johannesburg |
| LONDON LOGISTICS PTY LTD | maurice@lonlog.co.za | Randburg |
| M & S SHIPPING (PTY) LTD T/A M & S LOGISTICS | kreasonp@mslogisticsltd.com | Sandton |
| MAKHULU'S LOGISTIC SERVICES | magie.mls@polka.co.za | Johannesburg |
| MASIYA TRANSPORT AND TRADING | james.banda@masiyabiz.co.za | Jet park |
| MATALANA TRANSPORT AND LOGISTICS | info@matalana.co.za | Randvaal |
| MJV LOGISTICS | myan@mjvlogistics.co.za | Johannesburg |
| MOTION LINER | info@motionliner.co.za | Johannesburg |
| MS CARGO LOGISTICS INTERNATIONAL | operations@mscargo.co.za | Johannesburg |
| MSC LOGISTICS PTY LTD | distribution@msc.co.za | Johannesburg |
| MULTI LOG MULTIMODAL LOGISTICS SOLUTIONS (PTY) LTD | info@multilog.com | Germiston |

| Name of company | Email address | Location |
|---|---|---|
| MYLOGISTICS | info@mylogistics.co.za | Nort Riding |
| N G L LOGISTICS SOLUTIONS | quinton@ngllogistics.co.za | Boksburg |
| NASS CARRIERS | nasscarriers@mweb.co.za | Sandton |
| OCEAN FREIGHT & LOGISTICS (PTY) LTD | daan@oceanfreight.co.za | Krugersdorp |
| OPTILOG SUPPORT SERVCES | support@optilog.co.za | Centurion |
| P J S LOGISTICS | peter.moreki@pjslogistics.co.za | Vereeniging |
| PALM LOGISTICS | mario@palm-group.co.za | Heidelberg |
| PALOGIX INTERNATIONAL PTY LTD | rentals@palogix.com | Sandton |
| PERSONAL EFFECTS LOGISTICS (PTY) LTD | info@personaleffectslogistics.co.za | Kempton Park |
| PHOENIX INTERNATIONAL CC | bhart@phoenixintl.co.za | Sandton |
| PROMPT-PAC & PROMOTIONS | robj@prompt-pac.co.za | Kempton Park |
| QUAD INTERNATIONAL LOGISTICS | info@qilogistics.com | Kempton Park |
| REINHARDT TRANSPORT | hennie@reinhardt.co.za | Nigel |
| REUNERT DEFENCE LOGISTICS (PTY) LTD | enquiries@rdlog.co.za | Pretoria |
| REVERSE LOGISTICS (PTY) LTD | info@revlogs.co.za | Sandton |
| ROODRAND TRANSPORT | roodrandrsa@gmail.com | Roodepoort |
| RPD LOGISTICS | cleo@rpdlogistics.co.za | Johannesburg |
| RSA FREIGHT SERVICES | info@rsafreight.co.za | Edenvale |
| RTT GROUP | clinton.des@rtt.co.za | Johannesburg |
| RUBICA TRANSPORT | deon@sacitylink.co.za | Pretoria |
| SAB MILLER | hannah.harrison@sabmiller.com | Johannesburg |
| SADC BULK MANAGEMENT AND LOGISTICS (PTY) LTD | info@sadclogistics.co.za | Roodepoort |
| SAXPORT AGENCIES (PTY) LTD | info@saxport.co.za | Sandton |
| Sciophase (pty) LTD | 'hjosciophase@telkomsa.net' | Pretoria |
| SEMWAT TRANSPORT CC | semwat@mweb.co.za | Johannesburg |
| SINADAD LOGISTICS | michelle@sinadad.co.za | Benoni |
| SIZANANI LOGISTICS (PTY) LTD | christo@sizanani.com | Bedfordview |
| SKANKANE TRANSPORT | transport@skankane.co.za | Johannesburg |
| SKY AIR FREIGHT PTY LTD | eric@skyairfreight.co.za | Johannesburg |
| SKY SERVICES | info@skyservices.co.za | Johannesburg |
| SMC Transport | info@smctransportservices.co.za | Johannesburg |
| SOUTHGATE COURIERS | rudi@scsjhb.co.za | Boksburg |
| SPARTAN TRUCK HIRE & LOGISTICS (PTY) LTD | info@spartantruckhire.co.za | Kempton Park |
| SPEDAG SOUTH AFRICA | anand.reddy@za.spedag.com | Kempton Park |

| Name of company | Email address | Location |
|---|---|---|
| SSI-Schaefer | gordon@ssi-schaefer.co.za | Johannesburg |
| SUPER RENT | gauteng.sales@supergrp.com | Kempton Park |
| TANKER SERVICES | shevednab@tankerservices.co.za | Johannesburg |
| THANDANANI TRANSPORT | verna@ttpt.co.za | Edenvale |
| THE COURIER JUNXION | sales@junxion.za.net | Randburg |
| TOLL GLOBAL FORWARDING | elsabe.jonker@tollgroup.com | Kempton Park |
| TRADECORP LOGISTICS/UTI | farrah@tradecorplogistics.com | Jet Park |
| TRAFALGAR LOGISTICS (PTY) LTD | traftruck3@icon.co.za | Kempton Park |
| TRAGAR LOGISTICS | annalien@tragar.co.za | Edenvale |
| TRAMS IMPORTS AND EXPORTS | stanley@trams.co.za | Kempton Park |
| TRANSGLOBAL CARGO (PTY) LTD | fkarua@transglobal.co.ke | Kempton Park |
| TRANSMAC GROUP | adriaan@transmac.co.za | Nigel |
| TRANSNET | donald.joseph@transnet.net | Johannesburg |
| TRANSPORT BROKERS - A SUPER GROUP COMPANY | mervin@sacrossborder.co.za | Johannesburg |
| TRENSTAR | info@trenstar.co.za | Bedfordview |
| TRUCK AFRICA | charmain@truckafrica.co.za | Johannesburg |
| TRYDANT TRUCK HIRE | admin@trydant.co.za | Roodepoort |
| TWALAGLOBAL CARGO | simon@twalaglobal.co.za | Kempton Park |
| UNITRANS | Ursula.uys@unitrans.co.za | Johannesburg |
| VALUE GROUP LTD | pieters@value.co.za | Kempton Park |
| VANTAGE LOGISTICS | h-two@mweb.co.za | Meyerton |
| VECTOR LOGISTICS | HugoD@vectorlog.com | Centurion |
| VIRTUAL LOGISTICS | info@virtuallogistics.co.za | Jet Park |
| W S M TRANSPORT AND LOGISTICS | opsgvl@iafrica.com | Vereeniging |
| WOLFF LOGISTICS PTY LTD | rental@wcv.co.za | Pretoria |
| WORLDNET LOGISTICS | infojnb@worldnetlogistics.com | Edenvale |
| WORLDWIDE LOGISTICS | worldwide@mweb.co.za | Sandton |
| ZEBRA FREIGHT | chaps@zebrafreight.co.za | Kempton Park |

# Appendix E: Variable frequency data

**Companyturnover**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Less than R10 million | 2 | 5.6 | 5.6 | 5.6 |
| | R10 million - R100 million | 6 | 16.7 | 16.7 | 22.2 |
| | R101 - R150 million | 2 | 5.6 | 5.6 | 27.8 |
| | R151 -R500 million | 4 | 11.1 | 11.1 | 38.9 |
| | R500+ million | 21 | 58.3 | 58.3 | 97.2 |
| | Unsure | 1 | 2.8 | 2.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**Position**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Lower level management | 3 | 8.3 | 8.3 | 8.3 |
| | Middle level management | 21 | 58.3 | 58.3 | 66.7 |
| | Top level management | 12 | 33.3 | 33.3 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**Employee_number**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 001-10 000 | 8 | 22.2 | 22.2 | 22.2 |
| | 10 000+ | 12 | 33.3 | 33.3 | 55.6 |
| | 100-200 | 3 | 8.3 | 8.3 | 63.9 |
| | 201-1000 | 4 | 11.1 | 11.1 | 75.0 |
| | Less than 100 | 9 | 25.0 | 25.0 | 100.0 |

**Number_vehicles**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 10 - 100 | 8 | 22.2 | 22.2 | 22.2 |
| | 10 000+ | 4 | 11.1 | 11.1 | 33.3 |
| | 1001 - 10 000 | 8 | 22.2 | 22.2 | 55.6 |
| | 101 - 1000 | 10 | 27.8 | 27.8 | 83.3 |
| | Less than 10 | 4 | 11.1 | 11.1 | 94.4 |
| | Unsure | 2 | 5.6 | 5.6 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**Warehousesm2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 10 000-20 000 m2 | 5 | 13.9 | 13.9 | 13.9 |
| | 20 001-30 000 m2 | 1 | 2.8 | 2.8 | 16.7 |
| | 30 001-40 000 m2 | 3 | 8.3 | 8.3 | 25.0 |
| | 40 000 + m2 | 11 | 30.6 | 30.6 | 55.6 |
| | Less than 10 000 m2 | 7 | 19.4 | 19.4 | 75.0 |
| | Unsure | 9 | 25.0 | 25.0 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**Company_status**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Branch | 2 | 5.6 | 5.6 | 5.6 |
| | Head office | 19 | 52.8 | 52.8 | 58.3 |
| | Holding company | 3 | 8.3 | 8.3 | 66.7 |
| | Independent unit | 1 | 2.8 | 2.8 | 69.4 |
| | Other | 2 | 5.6 | 5.6 | 75.0 |
| | Subsidiary | 9 | 25.0 | 25.0 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**Status_company**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | | 34 | 94.4 | 94.4 | 94.4 |
| | State Owned Enterprise | 1 | 2.8 | 2.8 | 97.2 |
| | supply chain partners | 1 | 2.8 | 2.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**Aware_greenlogistics**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | No | 8 | 22.2 | 22.2 | 22.2 |
| | Yes | 28 | 77.8 | 77.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 2.8 | 2.8 |
| | 3 | 8 | 22.2 | 22.2 | 25.0 |
| | 4 | 20 | 55.6 | 55.6 | 80.6 |
| | 5 | 7 | 19.4 | 19.4 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 2.8 | 2.8 |
| | 2 | 2 | 5.6 | 5.6 | 8.3 |
| | 3 | 4 | 11.1 | 11.1 | 19.4 |
| | 4 | 11 | 30.6 | 30.6 | 50.0 |
| | 5 | 18 | 50.0 | 50.0 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 2.8 | 2.8 |
| | 1 | 1 | 2.8 | 2.8 | 5.6 |
| | 2 | 2 | 5.6 | 5.6 | 11.1 |
| | 3 | 7 | 19.4 | 19.4 | 30.6 |
| | 4 | 10 | 27.8 | 27.8 | 58.3 |
| | 5 | 15 | 41.7 | 41.7 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 2.8 | 2.8 |
| | 1 | 1 | 2.8 | 2.8 | 5.6 |
| | 3 | 4 | 11.1 | 11.1 | 16.7 |
| | 4 | 14 | 38.9 | 38.9 | 55.6 |
| | 5 | 16 | 44.4 | 44.4 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 7 | 19.4 | 19.4 | 19.4 |
| | 4 | 8 | 22.2 | 22.2 | 41.7 |
| | 5 | 21 | 58.3 | 58.3 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 5.6 | 5.6 |
| | 3 | 3 | 8.3 | 8.3 | 13.9 |
| | 4 | 12 | 33.3 | 33.3 | 47.2 |
| | 5 | 19 | 52.8 | 52.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 5.6 | 5.6 |
| | 4 | 16 | 44.4 | 44.4 | 50.0 |
| | 5 | 18 | 50.0 | 50.0 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 6 | 16.7 | 16.7 | 16.7 |
| | 4 | 17 | 47.2 | 47.2 | 63.9 |
| | 5 | 13 | 36.1 | 36.1 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 2.8 | 2.8 |
| | 3 | 5 | 13.9 | 13.9 | 16.7 |
| | 4 | 11 | 30.6 | 30.6 | 47.2 |
| | 5 | 19 | 52.8 | 52.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 5.6 | 5.6 |
| | 3 | 4 | 11.1 | 11.1 | 16.7 |
| | 4 | 11 | 30.6 | 30.6 | 47.2 |
| | 5 | 19 | 52.8 | 52.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 2.8 | 2.8 |
| | 3 | 2 | 5.6 | 5.6 | 8.3 |
| | 4 | 22 | 61.1 | 61.1 | 69.4 |
| | 5 | 11 | 30.6 | 30.6 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 5.7 | 5.7 |
| | 3 | 6 | 16.7 | 17.1 | 22.9 |
| | 4 | 9 | 25.0 | 25.7 | 48.6 |
| | 5 | 18 | 50.0 | 51.4 | 100.0 |
| | Total | 35 | 97.2 | 100.0 | |
| Missing | System | 1 | 2.8 | | |
| Total | | 36 | 100.0 | | |

**d13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 2.8 | 2.8 |
| | 2 | 3 | 8.3 | 8.3 | 11.1 |
| | 3 | 6 | 16.7 | 16.7 | 27.8 |
| | 4 | 8 | 22.2 | 22.2 | 50.0 |
| | 5 | 18 | 50.0 | 50.0 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 2.8 | 2.8 |
| | 2 | 3 | 8.3 | 8.3 | 11.1 |
| | 3 | 9 | 25.0 | 25.0 | 36.1 |
| | 4 | 10 | 27.8 | 27.8 | 63.9 |
| | 5 | 13 | 36.1 | 36.1 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 2.8 | 2.8 |
| | 3 | 4 | 11.1 | 11.1 | 13.9 |
| | 4 | 10 | 27.8 | 27.8 | 41.7 |
| | 5 | 21 | 58.3 | 58.3 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 5.7 | 5.7 |
| | 3 | 5 | 13.9 | 14.3 | 20.0 |
| | 4 | 10 | 27.8 | 28.6 | 48.6 |
| | 5 | 18 | 50.0 | 51.4 | 100.0 |
| | Total | 35 | 97.2 | 100.0 | |
| Missing | System | 1 | 2.8 | | |
| Total | | 36 | 100.0 | | |

**d17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 8.3 | 8.3 |
| | 4 | 13 | 36.1 | 36.1 | 44.4 |
| | 5 | 20 | 55.6 | 55.6 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 8.3 | 8.3 |
| | 4 | 14 | 38.9 | 38.9 | 47.2 |
| | 5 | 19 | 52.8 | 52.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**d19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 2.8 | 2.8 |
| | 2 | 1 | 2.8 | 2.8 | 5.6 |
| | 3 | 6 | 16.7 | 16.7 | 22.2 |
| | 4 | 18 | 50.0 | 50.0 | 72.2 |
| | 5 | 10 | 27.8 | 27.8 | 100.0 |
| | Total | 36 | 100.0 | 100.0 | |

**b1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.1 | 6.1 |
| | 3 | 4 | 11.1 | 12.1 | 18.2 |
| | 4 | 9 | 25.0 | 27.3 | 45.5 |
| | 5 | 18 | 50.0 | 54.5 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.1 | 6.1 |
| | 3 | 4 | 11.1 | 12.1 | 18.2 |
| | 4 | 13 | 36.1 | 39.4 | 57.6 |
| | 5 | 14 | 38.9 | 42.4 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 3.0 | 3.0 |
| | 3 | 3 | 8.3 | 9.1 | 12.1 |
| | 4 | 15 | 41.7 | 45.5 | 57.6 |
| | 5 | 14 | 38.9 | 42.4 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 5 | 13.9 | 15.2 | 15.2 |
| | 4 | 10 | 27.8 | 30.3 | 45.5 |
| | 5 | 18 | 50.0 | 54.5 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 4 | 11.1 | 12.1 | 12.1 |
| | 4 | 12 | 33.3 | 36.4 | 48.5 |
| | 5 | 17 | 47.2 | 51.5 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.1 | 6.1 |
| | 3 | 3 | 8.3 | 9.1 | 15.2 |
| | 4 | 8 | 22.2 | 24.2 | 39.4 |
| | 5 | 20 | 55.6 | 60.6 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 9.1 | 9.1 |
| | 4 | 12 | 33.3 | 36.4 | 45.5 |
| | 5 | 18 | 50.0 | 54.5 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 4 | 11.1 | 12.1 | 12.1 |
| | 4 | 14 | 38.9 | 42.4 | 54.5 |
| | 5 | 15 | 41.7 | 45.5 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 9.4 | 9.4 |
| | 3 | 4 | 11.1 | 12.5 | 21.9 |
| | 4 | 13 | 36.1 | 40.6 | 62.5 |
| | 5 | 12 | 33.3 | 37.5 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.1 | 6.1 |
| | 3 | 5 | 13.9 | 15.2 | 21.2 |
| | 4 | 14 | 38.9 | 42.4 | 63.6 |
| | 5 | 12 | 33.3 | 36.4 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.0 | 3.0 |
| | 3 | 2 | 5.6 | 6.1 | 9.1 |
| | 4 | 11 | 30.6 | 33.3 | 42.4 |
| | 5 | 19 | 52.8 | 57.6 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.1 | 6.1 |
| | 3 | 8 | 22.2 | 24.2 | 30.3 |
| | 4 | 11 | 30.6 | 33.3 | 63.6 |
| | 5 | 12 | 33.3 | 36.4 | 100.0 |
| | Total | 33 | 91.7 | 100.0 | |
| Missing | System | 3 | 8.3 | | |
| Total | | 36 | 100.0 | | |

**b13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.3 | 6.3 |
| | 3 | 5 | 13.9 | 15.6 | 21.9 |
| | 4 | 13 | 36.1 | 40.6 | 62.5 |
| | 5 | 12 | 33.3 | 37.5 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.1 | 3.1 |
| | 3 | 3 | 8.3 | 9.4 | 12.5 |
| | 4 | 12 | 33.3 | 37.5 | 50.0 |
| | 5 | 16 | 44.4 | 50.0 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 3 | 8.3 | 9.4 | 9.4 |
| | 2 | 1 | 2.8 | 3.1 | 12.5 |
| | 3 | 4 | 11.1 | 12.5 | 25.0 |
| | 4 | 14 | 38.9 | 43.8 | 68.8 |
| | 5 | 10 | 27.8 | 31.3 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 3 | 8.3 | 9.4 | 9.4 |
| | 2 | 1 | 2.8 | 3.1 | 12.5 |
| | 3 | 5 | 13.9 | 15.6 | 28.1 |
| | 4 | 10 | 27.8 | 31.3 | 59.4 |
| | 5 | 13 | 36.1 | 40.6 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 6 | 16.7 | 18.8 | 18.8 |
| | 4 | 12 | 33.3 | 37.5 | 56.3 |
| | 5 | 14 | 38.9 | 43.8 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.3 | 6.3 |
| | 3 | 3 | 8.3 | 9.4 | 15.6 |
| | 4 | 13 | 36.1 | 40.6 | 56.3 |
| | 5 | 14 | 38.9 | 43.8 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.1 | 3.1 |
| | 3 | 2 | 5.6 | 6.3 | 9.4 |
| | 4 | 9 | 25.0 | 28.1 | 37.5 |
| | 5 | 20 | 55.6 | 62.5 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b20**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 3.1 | 3.1 |
| | 2 | 1 | 2.8 | 3.1 | 6.3 |
| | 3 | 5 | 13.9 | 15.6 | 21.9 |
| | 4 | 7 | 19.4 | 21.9 | 43.8 |
| | 5 | 18 | 50.0 | 56.3 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**b21**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 9.4 | 9.4 |
| | 3 | 4 | 11.1 | 12.5 | 21.9 |
| | 4 | 12 | 33.3 | 37.5 | 59.4 |
| | 5 | 13 | 36.1 | 40.6 | 100.0 |
| | Total | 32 | 88.9 | 100.0 | |
| Missing | System | 4 | 11.1 | | |
| Total | | 36 | 100.0 | | |

**ba1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 6.9 | 6.9 |
| | 3 | 11 | 30.6 | 37.9 | 44.8 |
| | 4 | 12 | 33.3 | 41.4 | 86.2 |
| | 5 | 4 | 11.1 | 13.8 | 100.0 |
| | Total | 29 | 80.6 | 100.0 | |
| Missing | System | 7 | 19.4 | | |
| Total | | 36 | 100.0 | | |

**ba2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 10.3 | 10.3 |
| | 3 | 10 | 27.8 | 34.5 | 44.8 |
| | 4 | 11 | 30.6 | 37.9 | 82.8 |
| | 5 | 5 | 13.9 | 17.2 | 100.0 |
| | Total | 29 | 80.6 | 100.0 | |
| Missing | System | 7 | 19.4 | | |
| Total | | 36 | 100.0 | | |

**ba3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 10.7 | 10.7 |
| | 3 | 10 | 27.8 | 35.7 | 46.4 |
| | 4 | 9 | 25.0 | 32.1 | 78.6 |
| | 5 | 6 | 16.7 | 21.4 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.6 | 3.6 |
| | 3 | 6 | 16.7 | 21.4 | 25.0 |
| | 4 | 15 | 41.7 | 53.6 | 78.6 |
| | 5 | 6 | 16.7 | 21.4 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 7.1 | 7.1 |
| | 3 | 7 | 19.4 | 25.0 | 32.1 |
| | 4 | 12 | 33.3 | 42.9 | 75.0 |
| | 5 | 7 | 19.4 | 25.0 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 3.6 | 3.6 |
| | 2 | 1 | 2.8 | 3.6 | 7.1 |
| | 3 | 7 | 19.4 | 25.0 | 32.1 |
| | 4 | 7 | 19.4 | 25.0 | 57.1 |
| | 5 | 12 | 33.3 | 42.9 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.6 | 3.6 |
| | 3 | 7 | 19.4 | 25.0 | 28.6 |
| | 4 | 12 | 33.3 | 42.9 | 71.4 |
| | 5 | 8 | 22.2 | 28.6 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.6 | 3.6 |
| | 3 | 7 | 19.4 | 25.0 | 28.6 |
| | 4 | 11 | 30.6 | 39.3 | 67.9 |
| | 5 | 9 | 25.0 | 32.1 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 14.3 | 14.3 |
| | 3 | 6 | 16.7 | 21.4 | 35.7 |
| | 4 | 7 | 19.4 | 25.0 | 60.7 |
| | 5 | 11 | 30.6 | 39.3 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 3.6 | 3.6 |
| | 2 | 2 | 5.6 | 7.1 | 10.7 |
| | 3 | 6 | 16.7 | 21.4 | 32.1 |
| | 4 | 10 | 27.8 | 35.7 | 67.9 |
| | 5 | 9 | 25.0 | 32.1 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 10.7 | 10.7 |
| | 3 | 6 | 16.7 | 21.4 | 32.1 |
| | 4 | 13 | 36.1 | 46.4 | 78.6 |
| | 5 | 6 | 16.7 | 21.4 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 6 | 16.7 | 21.4 | 21.4 |
| | 4 | 11 | 30.6 | 39.3 | 60.7 |
| | 5 | 11 | 30.6 | 39.3 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 10.7 | 10.7 |
| | 3 | 11 | 30.6 | 39.3 | 50.0 |
| | 4 | 7 | 19.4 | 25.0 | 75.0 |
| | 5 | 7 | 19.4 | 25.0 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 7 | 19.4 | 25.0 | 25.0 |
| | 4 | 11 | 30.6 | 39.3 | 64.3 |
| | 5 | 10 | 27.8 | 35.7 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.7 | 3.7 |
| | 3 | 9 | 25.0 | 33.3 | 37.0 |
| | 4 | 10 | 27.8 | 37.0 | 74.1 |
| | 5 | 7 | 19.4 | 25.9 | 100.0 |
| | Total | 27 | 75.0 | 100.0 | |
| Missing | System | 9 | 25.0 | | |
| Total | | 36 | 100.0 | | |

**ba16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.6 | 3.6 |
| | 3 | 7 | 19.4 | 25.0 | 28.6 |
| | 4 | 12 | 33.3 | 42.9 | 71.4 |
| | 5 | 8 | 22.2 | 28.6 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 14.3 | 14.3 |
| | 3 | 8 | 22.2 | 28.6 | 42.9 |
| | 4 | 8 | 22.2 | 28.6 | 71.4 |
| | 5 | 8 | 22.2 | 28.6 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.6 | 3.6 |
| | 3 | 4 | 11.1 | 14.3 | 17.9 |
| | 4 | 15 | 41.7 | 53.6 | 71.4 |
| | 5 | 8 | 22.2 | 28.6 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 3.6 | 3.6 |
| | 3 | 4 | 11.1 | 14.3 | 17.9 |
| | 4 | 16 | 44.4 | 57.1 | 75.0 |
| | 5 | 7 | 19.4 | 25.0 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**ba20**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 3.6 | 3.6 |
| | 2 | 1 | 2.8 | 3.6 | 7.1 |
| | 3 | 11 | 30.6 | 39.3 | 46.4 |
| | 4 | 7 | 19.4 | 25.0 | 71.4 |
| | 5 | 8 | 22.2 | 28.6 | 100.0 |
| | Total | 28 | 77.8 | 100.0 | |
| Missing | System | 8 | 22.2 | | |
| Total | | 36 | 100.0 | | |

**St1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 2 | 5.6 | 8.7 | 13.0 |
| | 3 | 4 | 11.1 | 17.4 | 30.4 |
| | 4 | 9 | 25.0 | 39.1 | 69.6 |
| | 5 | 7 | 19.4 | 30.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 1 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 7 | 19.4 | 30.4 | 39.1 |
| | 4 | 7 | 19.4 | 30.4 | 69.6 |
| | 5 | 7 | 19.4 | 30.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 8.7 | 8.7 |
| | 1 | 3 | 8.3 | 13.0 | 21.7 |
| | 2 | 3 | 8.3 | 13.0 | 34.8 |
| | 3 | 9 | 25.0 | 39.1 | 73.9 |
| | 4 | 2 | 5.6 | 8.7 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 4 | 11.1 | 17.4 | 17.4 |
| | 1 | 1 | 2.8 | 4.3 | 21.7 |
| | 3 | 3 | 8.3 | 13.0 | 34.8 |
| | 4 | 9 | 25.0 | 39.1 | 73.9 |
| | 5 | 6 | 16.7 | 26.1 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.5 | 4.5 |
| | 2 | 2 | 5.6 | 9.1 | 13.6 |
| | 3 | 6 | 16.7 | 27.3 | 40.9 |
| | 4 | 6 | 16.7 | 27.3 | 68.2 |
| | 5 | 7 | 19.4 | 31.8 | 100.0 |
| | Total | 22 | 61.1 | 100.0 | |
| Missing | System | 14 | 38.9 | | |
| Total | | 36 | 100.0 | | |

**St6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.5 | 4.5 |
| | 2 | 2 | 5.6 | 9.1 | 13.6 |
| | 3 | 7 | 19.4 | 31.8 | 45.5 |
| | 4 | 8 | 22.2 | 36.4 | 81.8 |
| | 5 | 4 | 11.1 | 18.2 | 100.0 |
| | Total | 22 | 61.1 | 100.0 | |
| Missing | System | 14 | 38.9 | | |
| Total | | 36 | 100.0 | | |

**St7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 13.0 | 13.0 |
| | 3 | 3 | 8.3 | 13.0 | 26.1 |
| | 4 | 5 | 13.9 | 21.7 | 47.8 |
| | 5 | 12 | 33.3 | 52.2 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 11 | 30.6 | 47.8 | 56.5 |
| | 4 | 6 | 16.7 | 26.1 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 17.4 | 17.4 |
| | 3 | 7 | 19.4 | 30.4 | 47.8 |
| | 4 | 5 | 13.9 | 21.7 | 69.6 |
| | 5 | 7 | 19.4 | 30.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 7 | 19.4 | 30.4 | 39.1 |
| | 4 | 10 | 27.8 | 43.5 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 3 | 8.3 | 13.0 | 21.7 |
| | 4 | 11 | 30.6 | 47.8 | 69.6 |
| | 5 | 7 | 19.4 | 30.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 5 | 13.9 | 21.7 | 30.4 |
| | 4 | 11 | 30.6 | 47.8 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 5 | 13.9 | 21.7 | 21.7 |
| | 4 | 5 | 13.9 | 21.7 | 43.5 |
| | 5 | 13 | 36.1 | 56.5 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 5 | 13.9 | 21.7 | 26.1 |
| | 3 | 9 | 25.0 | 39.1 | 65.2 |
| | 4 | 4 | 11.1 | 17.4 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 8.7 | 8.7 |
| | 3 | 7 | 19.4 | 30.4 | 39.1 |
| | 4 | 5 | 13.9 | 21.7 | 60.9 |
| | 5 | 9 | 25.0 | 39.1 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 3 | 8.3 | 13.0 | 17.4 |
| | 3 | 11 | 30.6 | 47.8 | 65.2 |
| | 4 | 6 | 16.7 | 26.1 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 8.7 | 8.7 |
| | 4 | 8 | 22.2 | 34.8 | 43.5 |
| | 5 | 13 | 36.1 | 56.5 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**St18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 4 | 11.1 | 17.4 | 21.7 |
| | 3 | 5 | 13.9 | 21.7 | 43.5 |
| | 4 | 10 | 27.8 | 43.5 | 87.0 |
| | 5 | 3 | 8.3 | 13.0 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 2 | 5.6 | 8.7 | 13.0 |
| | 3 | 9 | 25.0 | 39.1 | 52.2 |
| | 4 | 6 | 16.7 | 26.1 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 1 | 1 | 2.8 | 4.3 | 8.7 |
| | 2 | 10 | 27.8 | 43.5 | 52.2 |
| | 3 | 6 | 16.7 | 26.1 | 78.3 |
| | 4 | 3 | 8.3 | 13.0 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 6 | 16.7 | 26.1 | 26.1 |
| | 4 | 12 | 33.3 | 52.2 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 5 | 13.9 | 21.7 | 21.7 |
| | 3 | 6 | 16.7 | 26.1 | 47.8 |
| | 4 | 9 | 25.0 | 39.1 | 87.0 |
| | 5 | 3 | 8.3 | 13.0 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 2 | 5.6 | 8.7 | 13.0 |
| | 3 | 6 | 16.7 | 26.1 | 39.1 |
| | 4 | 9 | 25.0 | 39.1 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 3 | 8.3 | 13.0 | 13.0 |
| | 2 | 5 | 13.9 | 21.7 | 34.8 |
| | 3 | 9 | 25.0 | 39.1 | 73.9 |
| | 4 | 3 | 8.3 | 13.0 | 87.0 |
| | 5 | 3 | 8.3 | 13.0 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 9 | 25.0 | 39.1 | 39.1 |
| | 4 | 7 | 19.4 | 30.4 | 69.6 |
| | 5 | 7 | 19.4 | 30.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 6 | 16.7 | 26.1 | 26.1 |
| | 3 | 5 | 13.9 | 21.7 | 47.8 |
| | 4 | 8 | 22.2 | 34.8 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 2 | 5.6 | 8.7 | 13.0 |
| | 3 | 3 | 8.3 | 13.0 | 26.1 |
| | 4 | 11 | 30.6 | 47.8 | 73.9 |
| | 5 | 6 | 16.7 | 26.1 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 1 | 2 | 5.6 | 8.7 | 13.0 |
| | 2 | 8 | 22.2 | 34.8 | 47.8 |
| | 3 | 4 | 11.1 | 17.4 | 65.2 |
| | 4 | 6 | 16.7 | 26.1 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 8.7 | 8.7 |
| | 2 | 2 | 5.6 | 8.7 | 17.4 |
| | 3 | 10 | 27.8 | 43.5 | 60.9 |
| | 4 | 6 | 16.7 | 26.1 | 87.0 |
| | 5 | 3 | 8.3 | 13.0 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 8.7 | 8.7 |
| | 1 | 1 | 2.8 | 4.3 | 13.0 |
| | 2 | 4 | 11.1 | 17.4 | 30.4 |
| | 3 | 10 | 27.8 | 43.5 | 73.9 |
| | 4 | 4 | 11.1 | 17.4 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 8.7 | 8.7 |
| | 3 | 2 | 5.6 | 8.7 | 17.4 |
| | 4 | 10 | 27.8 | 43.5 | 60.9 |
| | 5 | 9 | 25.0 | 39.1 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 13.0 | 13.0 |
| | 3 | 5 | 13.9 | 21.7 | 34.8 |
| | 4 | 11 | 30.6 | 47.8 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 8.7 | 8.7 |
| | 2 | 1 | 2.8 | 4.3 | 13.0 |
| | 3 | 7 | 19.4 | 30.4 | 43.5 |
| | 4 | 9 | 25.0 | 39.1 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 8.7 | 8.7 |
| | 1 | 2 | 5.6 | 8.7 | 17.4 |
| | 2 | 3 | 8.3 | 13.0 | 30.4 |
| | 3 | 8 | 22.2 | 34.8 | 65.2 |
| | 4 | 6 | 16.7 | 26.1 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 3 | 8.3 | 13.0 | 17.4 |
| | 3 | 3 | 8.3 | 13.0 | 30.4 |
| | 4 | 11 | 30.6 | 47.8 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Ta18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 6 | 16.7 | 26.1 | 30.4 |
| | 3 | 4 | 11.1 | 17.4 | 47.8 |
| | 4 | 8 | 22.2 | 34.8 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 4 | 13 | 36.1 | 56.5 | 65.2 |
| | 5 | 8 | 22.2 | 34.8 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 1 | 4 | 11.1 | 17.4 | 21.7 |
| | 2 | 9 | 25.0 | 39.1 | 60.9 |
| | 3 | 5 | 13.9 | 21.7 | 82.6 |
| | 4 | 3 | 8.3 | 13.0 | 95.7 |
| | 5 | 1 | 2.8 | 4.3 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 1 | 2.8 | 4.3 | 13.0 |
| | 4 | 2 | 5.6 | 8.7 | 21.7 |
| | 5 | 18 | 50.0 | 78.3 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 7 | 19.4 | 30.4 | 30.4 |
| | 3 | 7 | 19.4 | 30.4 | 60.9 |
| | 4 | 8 | 22.2 | 34.8 | 95.7 |
| | 5 | 1 | 2.8 | 4.3 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 3 | 1 | 2.8 | 4.3 | 8.7 |
| | 4 | 8 | 22.2 | 34.8 | 43.5 |
| | 5 | 13 | 36.1 | 56.5 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 4 | 11.1 | 17.4 | 21.7 |
| | 3 | 8 | 22.2 | 34.8 | 56.5 |
| | 4 | 7 | 19.4 | 30.4 | 87.0 |
| | 5 | 3 | 8.3 | 13.0 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 4 | 11.1 | 17.4 | 26.1 |
| | 4 | 11 | 30.6 | 47.8 | 73.9 |
| | 5 | 6 | 16.7 | 26.1 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 1 | 5 | 13.9 | 21.7 | 26.1 |
| | 2 | 6 | 16.7 | 26.1 | 52.2 |
| | 3 | 4 | 11.1 | 17.4 | 69.6 |
| | 4 | 6 | 16.7 | 26.1 | 95.7 |
| | 5 | 1 | 2.8 | 4.3 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 4.3 | 4.3 |
| | 4 | 9 | 25.0 | 39.1 | 43.5 |
| | 5 | 13 | 36.1 | 56.5 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 5 | 13.9 | 21.7 | 21.7 |
| | 3 | 10 | 27.8 | 43.5 | 65.2 |
| | 4 | 6 | 16.7 | 26.1 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 8.7 | 8.7 |
| | 4 | 9 | 25.0 | 39.1 | 47.8 |
| | 5 | 12 | 33.3 | 52.2 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 8.7 | 8.7 |
| | 3 | 9 | 25.0 | 39.1 | 47.8 |
| | 4 | 7 | 19.4 | 30.4 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 3 | 3 | 8.3 | 13.0 | 17.4 |
| | 4 | 8 | 22.2 | 34.8 | 52.2 |
| | 5 | 11 | 30.6 | 47.8 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 3 | 8.3 | 13.0 | 17.4 |
| | 3 | 5 | 13.9 | 21.7 | 39.1 |
| | 4 | 9 | 25.0 | 39.1 | 78.3 |
| | 5 | 5 | 13.9 | 21.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 2 | 5.6 | 8.7 | 13.0 |
| | 3 | 5 | 13.9 | 21.7 | 34.8 |
| | 4 | 9 | 25.0 | 39.1 | 73.9 |
| | 5 | 6 | 16.7 | 26.1 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 4 | 11.1 | 17.4 | 21.7 |
| | 3 | 8 | 22.2 | 34.8 | 56.5 |
| | 4 | 8 | 22.2 | 34.8 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 2 | 1 | 2.8 | 4.3 | 8.7 |
| | 3 | 6 | 16.7 | 26.1 | 34.8 |
| | 4 | 7 | 19.4 | 30.4 | 65.2 |
| | 5 | 8 | 22.2 | 34.8 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 6 | 16.7 | 26.1 | 26.1 |
| | 3 | 9 | 25.0 | 39.1 | 65.2 |
| | 4 | 6 | 16.7 | 26.1 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 3 | 2 | 5.6 | 8.7 | 13.0 |
| | 4 | 6 | 16.7 | 26.1 | 39.1 |
| | 5 | 14 | 38.9 | 60.9 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op20**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.3 | 4.3 |
| | 1 | 1 | 2.8 | 4.3 | 8.7 |
| | 2 | 6 | 16.7 | 26.1 | 34.8 |
| | 3 | 1 | 2.8 | 4.3 | 39.1 |
| | 4 | 10 | 27.8 | 43.5 | 82.6 |
| | 5 | 4 | 11.1 | 17.4 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op21**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 4.3 | 4.3 |
| | 3 | 4 | 11.1 | 17.4 | 21.7 |
| | 4 | 8 | 22.2 | 34.8 | 56.5 |
| | 5 | 10 | 27.8 | 43.5 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Op22**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 5 | 13.9 | 21.7 | 21.7 |
| | 3 | 9 | 25.0 | 39.1 | 60.9 |
| | 4 | 7 | 19.4 | 30.4 | 91.3 |
| | 5 | 2 | 5.6 | 8.7 | 100.0 |
| | Total | 23 | 63.9 | 100.0 | |
| Missing | System | 13 | 36.1 | | |
| Total | | 36 | 100.0 | | |

**Or1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 1 | 2.8 | 4.8 | 4.8 |
| | 4 | 5 | 13.9 | 23.8 | 28.6 |
| | 5 | 15 | 41.7 | 71.4 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 4 | 11.1 | 19.0 | 28.6 |
| | 3 | 3 | 8.3 | 14.3 | 42.9 |
| | 4 | 10 | 27.8 | 47.6 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 1 | 1 | 2.8 | 4.8 | 14.3 |
| | 3 | 4 | 11.1 | 19.0 | 33.3 |
| | 4 | 8 | 22.2 | 38.1 | 71.4 |
| | 5 | 6 | 16.7 | 28.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 1 | 1 | 2.8 | 4.8 | 14.3 |
| | 2 | 4 | 11.1 | 19.0 | 33.3 |
| | 3 | 6 | 16.7 | 28.6 | 61.9 |
| | 4 | 6 | 16.7 | 28.6 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 7 | 19.4 | 33.3 | 38.1 |
| | 4 | 7 | 19.4 | 33.3 | 71.4 |
| | 5 | 6 | 16.7 | 28.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 1 | 2.8 | 4.8 | 9.5 |
| | 3 | 6 | 16.7 | 28.6 | 38.1 |
| | 4 | 6 | 16.7 | 28.6 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 4 | 11.1 | 19.0 | 23.8 |
| | 4 | 4 | 11.1 | 19.0 | 42.9 |
| | 5 | 12 | 33.3 | 57.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 3 | 8.3 | 14.3 | 19.0 |
| | 3 | 6 | 16.7 | 28.6 | 47.6 |
| | 4 | 6 | 16.7 | 28.6 | 76.2 |
| | 5 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 9.5 | 9.5 |
| | 4 | 6 | 16.7 | 28.6 | 38.1 |
| | 5 | 13 | 36.1 | 61.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 4 | 11.1 | 19.0 | 28.6 |
| | 3 | 7 | 19.4 | 33.3 | 61.9 |
| | 4 | 7 | 19.4 | 33.3 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 1 | 2.8 | 4.8 | 14.3 |
| | 3 | 3 | 8.3 | 14.3 | 28.6 |
| | 4 | 9 | 25.0 | 42.9 | 71.4 |
| | 5 | 6 | 16.7 | 28.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 8 | 22.2 | 38.1 | 47.6 |
| | 4 | 9 | 25.0 | 42.9 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 1 | 2.8 | 4.8 | 4.8 |
| | 4 | 6 | 16.7 | 28.6 | 33.3 |
| | 5 | 14 | 38.9 | 66.7 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 5 | 13.9 | 23.8 | 33.3 |
| | 3 | 5 | 13.9 | 23.8 | 57.1 |
| | 4 | 9 | 25.0 | 42.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 19.0 | 19.0 |
| | 3 | 7 | 19.4 | 33.3 | 52.4 |
| | 4 | 3 | 8.3 | 14.3 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 1 | 1 | 2.8 | 4.8 | 9.5 |
| | 2 | 4 | 11.1 | 19.0 | 28.6 |
| | 3 | 8 | 22.2 | 38.1 | 66.7 |
| | 4 | 4 | 11.1 | 19.0 | 85.7 |
| | 5 | 3 | 8.3 | 14.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 4 | 11.1 | 19.0 | 19.0 |
| | 4 | 9 | 25.0 | 42.9 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 9 | 25.0 | 42.9 | 52.4 |
| | 4 | 6 | 16.7 | 28.6 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 1 | 1 | 2.8 | 4.8 | 9.5 |
| | 2 | 2 | 5.6 | 9.5 | 19.0 |
| | 3 | 3 | 8.3 | 14.3 | 33.3 |
| | 4 | 3 | 8.3 | 14.3 | 47.6 |
| | 5 | 11 | 30.6 | 52.4 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or20**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 4 | 11.1 | 19.0 | 28.6 |
| | 4 | 10 | 27.8 | 47.6 | 76.2 |
| | 5 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or21**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 9.5 | 9.5 |
| | 4 | 9 | 25.0 | 42.9 | 52.4 |
| | 5 | 10 | 27.8 | 47.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or22**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 19.0 | 19.0 |
| | 3 | 10 | 27.8 | 47.6 | 66.7 |
| | 4 | 5 | 13.9 | 23.8 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or23**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 14.3 | 14.3 |
| | 4 | 9 | 25.0 | 42.9 | 57.1 |
| | 5 | 9 | 25.0 | 42.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or24**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 3 | 8.3 | 14.3 | 14.3 |
| | 3 | 6 | 16.7 | 28.6 | 42.9 |
| | 4 | 9 | 25.0 | 42.9 | 85.7 |
| | 5 | 3 | 8.3 | 14.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or25**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 5 | 13.9 | 23.8 | 23.8 |
| | 4 | 7 | 19.4 | 33.3 | 57.1 |
| | 5 | 9 | 25.0 | 42.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or26**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 7 | 19.4 | 33.3 | 38.1 |
| | 4 | 8 | 22.2 | 38.1 | 76.2 |
| | 5 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or27**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 1 | 2.8 | 4.8 | 4.8 |
| | 4 | 7 | 19.4 | 33.3 | 38.1 |
| | 5 | 13 | 36.1 | 61.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or28**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 3 | 8.3 | 14.3 | 23.8 |
| | 3 | 11 | 30.6 | 52.4 | 76.2 |
| | 4 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or29**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 14.3 | 14.3 |
| | 4 | 7 | 19.4 | 33.3 | 47.6 |
| | 5 | 11 | 30.6 | 52.4 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or30**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 10 | 27.8 | 47.6 | 57.1 |
| | 4 | 9 | 25.0 | 42.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or31**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 4 | 4 | 11.1 | 19.0 | 19.0 |
| | 5 | 17 | 47.2 | 81.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Or32**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 3 | 8.3 | 14.3 | 19.0 |
| | 3 | 6 | 16.7 | 28.6 | 47.6 |
| | 4 | 10 | 27.8 | 47.6 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 1 | 2.8 | 4.8 | 4.8 |
| | 4 | 10 | 27.8 | 47.6 | 52.4 |
| | 5 | 10 | 27.8 | 47.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 5 | 13.9 | 23.8 | 23.8 |
| | 3 | 8 | 22.2 | 38.1 | 61.9 |
| | 4 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 5 | 13.9 | 23.8 | 28.6 |
| | 4 | 8 | 22.2 | 38.1 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 4 | 11.1 | 19.0 | 23.8 |
| | 3 | 8 | 22.2 | 38.1 | 61.9 |
| | 4 | 6 | 16.7 | 28.6 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 5 | 13.9 | 23.8 | 23.8 |
| | 4 | 7 | 19.4 | 33.3 | 57.1 |
| | 5 | 9 | 25.0 | 42.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 4 | 11.1 | 19.0 | 28.6 |
| | 3 | 7 | 19.4 | 33.3 | 61.9 |
| | 4 | 5 | 13.9 | 23.8 | 85.7 |
| | 5 | 3 | 8.3 | 14.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 1 | 2.8 | 4.8 | 14.3 |
| | 3 | 6 | 16.7 | 28.6 | 42.9 |
| | 4 | 5 | 13.9 | 23.8 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 3 | 8.3 | 14.3 | 14.3 |
| | 2 | 4 | 11.1 | 19.0 | 33.3 |
| | 3 | 6 | 16.7 | 28.6 | 61.9 |
| | 4 | 5 | 13.9 | 23.8 | 85.7 |
| | 5 | 3 | 8.3 | 14.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 8 | 22.2 | 38.1 | 47.6 |
| | 4 | 6 | 16.7 | 28.6 | 76.2 |
| | 5 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 19.0 | 19.0 |
| | 3 | 8 | 22.2 | 38.1 | 57.1 |
| | 4 | 5 | 13.9 | 23.8 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 4 | 11.1 | 19.0 | 19.0 |
| | 1 | 2 | 5.6 | 9.5 | 28.6 |
| | 2 | 3 | 8.3 | 14.3 | 42.9 |
| | 3 | 3 | 8.3 | 14.3 | 57.1 |
| | 4 | 5 | 13.9 | 23.8 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 5 | 13.9 | 23.8 | 23.8 |
| | 2 | 2 | 5.6 | 9.5 | 33.3 |
| | 3 | 2 | 5.6 | 9.5 | 42.9 |
| | 4 | 8 | 22.2 | 38.1 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 1 | 2.8 | 4.8 | 9.5 |
| | 3 | 4 | 11.1 | 19.0 | 28.6 |
| | 4 | 5 | 13.9 | 23.8 | 52.4 |
| | 5 | 10 | 27.8 | 47.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 4 | 11.1 | 19.0 | 23.8 |
| | 3 | 4 | 11.1 | 19.0 | 42.9 |
| | 4 | 4 | 11.1 | 19.0 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 14.3 | 14.3 |
| | 4 | 4 | 11.1 | 19.0 | 33.3 |
| | 5 | 14 | 38.9 | 66.7 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 3 | 8.3 | 14.3 | 14.3 |
| | 2 | 9 | 25.0 | 42.9 | 57.1 |
| | 3 | 5 | 13.9 | 23.8 | 81.0 |
| | 4 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 3 | 8.3 | 14.3 | 19.0 |
| | 3 | 6 | 16.7 | 28.6 | 47.6 |
| | 4 | 4 | 11.1 | 19.0 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 5 | 13.9 | 23.8 | 33.3 |
| | 3 | 8 | 22.2 | 38.1 | 71.4 |
| | 4 | 2 | 5.6 | 9.5 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 1 | 1 | 2.8 | 4.8 | 14.3 |
| | 2 | 5 | 13.9 | 23.8 | 38.1 |
| | 3 | 2 | 5.6 | 9.5 | 47.6 |
| | 4 | 4 | 11.1 | 19.0 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te20**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 1 | 1 | 2.8 | 4.8 | 14.3 |
| | 3 | 2 | 5.6 | 9.5 | 23.8 |
| | 4 | 2 | 5.6 | 9.5 | 33.3 |
| | 5 | 14 | 38.9 | 66.7 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te21**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 1 | 2.8 | 4.8 | 4.8 |
| | 4 | 8 | 22.2 | 38.1 | 42.9 |
| | 5 | 12 | 33.3 | 57.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te22**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 8 | 22.2 | 38.1 | 42.9 |
| | 3 | 4 | 11.1 | 19.0 | 61.9 |
| | 4 | 5 | 13.9 | 23.8 | 85.7 |
| | 5 | 3 | 8.3 | 14.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te23**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 14.3 | 14.3 |
| | 4 | 6 | 16.7 | 28.6 | 42.9 |
| | 5 | 12 | 33.3 | 57.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te24**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 10 | 27.8 | 47.6 | 57.1 |
| | 4 | 8 | 22.2 | 38.1 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te25**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 9.5 | 9.5 |
| | 4 | 11 | 30.6 | 52.4 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te26**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 9 | 25.0 | 42.9 | 52.4 |
| | 4 | 8 | 22.2 | 38.1 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te27**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 2 | 5.6 | 9.5 | 19.0 |
| | 3 | 3 | 8.3 | 14.3 | 33.3 |
| | 4 | 6 | 16.7 | 28.6 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te28**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 2 | 5.6 | 9.5 | 9.5 |
| | 1 | 1 | 2.8 | 4.8 | 14.3 |
| | 2 | 5 | 13.9 | 23.8 | 38.1 |
| | 3 | 3 | 8.3 | 14.3 | 52.4 |
| | 4 | 4 | 11.1 | 19.0 | 71.4 |
| | 5 | 6 | 16.7 | 28.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te29**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 9.5 | 9.5 |
| | 4 | 11 | 30.6 | 52.4 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te30**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 4 | 11.1 | 19.0 | 19.0 |
| | 3 | 9 | 25.0 | 42.9 | 61.9 |
| | 4 | 4 | 11.1 | 19.0 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te31**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 1 | 2.8 | 4.8 | 9.5 |
| | 4 | 12 | 33.3 | 57.1 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te32**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 4 | 11.1 | 19.0 | 23.8 |
| | 3 | 10 | 27.8 | 47.6 | 71.4 |
| | 4 | 4 | 11.1 | 19.0 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te33**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 1 | 2.8 | 4.8 | 4.8 |
| | 2 | 5 | 13.9 | 23.8 | 28.6 |
| | 3 | 8 | 22.2 | 38.1 | 66.7 |
| | 4 | 3 | 8.3 | 14.3 | 81.0 |
| | 5 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**Te34**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 5 | 13.9 | 23.8 | 33.3 |
| | 4 | 8 | 22.2 | 38.1 | 71.4 |
| | 5 | 6 | 16.7 | 28.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 2 | 5.6 | 9.5 | 9.5 |
| | 4 | 7 | 19.4 | 33.3 | 42.9 |
| | 5 | 12 | 33.3 | 57.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 4 | 11.1 | 19.0 | 19.0 |
| | 2 | 10 | 27.8 | 47.6 | 66.7 |
| | 3 | 3 | 8.3 | 14.3 | 81.0 |
| | 4 | 4 | 11.1 | 19.0 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 3 | 8.3 | 14.3 | 14.3 |
| | 4 | 6 | 16.7 | 28.6 | 42.9 |
| | 5 | 12 | 33.3 | 57.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 4 | 11.1 | 19.0 | 19.0 |
| | 2 | 10 | 27.8 | 47.6 | 66.7 |
| | 3 | 5 | 13.9 | 23.8 | 90.5 |
| | 4 | 1 | 2.8 | 4.8 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 4 | 3 | 8.3 | 14.3 | 14.3 |
| | 5 | 18 | 50.0 | 85.7 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 3 | 8.3 | 14.3 | 14.3 |
| | 2 | 6 | 16.7 | 28.6 | 42.9 |
| | 3 | 7 | 19.4 | 33.3 | 76.2 |
| | 4 | 4 | 11.1 | 19.0 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In7**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 2 | 5.6 | 9.5 | 14.3 |
| | 4 | 5 | 13.9 | 23.8 | 38.1 |
| | 5 | 13 | 36.1 | 61.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In8**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 4 | 11.1 | 19.0 | 19.0 |
| | 2 | 9 | 25.0 | 42.9 | 61.9 |
| | 3 | 4 | 11.1 | 19.0 | 81.0 |
| | 4 | 3 | 8.3 | 14.3 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In9**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 4 | 10 | 27.8 | 47.6 | 57.1 |
| | 5 | 9 | 25.0 | 42.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In10**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 3 | 8.3 | 14.3 | 14.3 |
| | 2 | 6 | 16.7 | 28.6 | 42.9 |
| | 3 | 6 | 16.7 | 28.6 | 71.4 |
| | 4 | 6 | 16.7 | 28.6 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In11**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 2 | 5.6 | 9.5 | 14.3 |
| | 4 | 10 | 27.8 | 47.6 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In12**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 4 | 11.1 | 19.0 | 19.0 |
| | 2 | 8 | 22.2 | 38.1 | 57.1 |
| | 3 | 7 | 19.4 | 33.3 | 90.5 |
| | 4 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In13**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 1 | 2.8 | 4.8 | 4.8 |
| | 4 | 7 | 19.4 | 33.3 | 38.1 |
| | 5 | 13 | 36.1 | 61.9 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In14**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 4 | 11.1 | 19.0 | 19.0 |
| | 2 | 9 | 25.0 | 42.9 | 61.9 |
| | 3 | 3 | 8.3 | 14.3 | 76.2 |
| | 4 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In15**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 9 | 25.0 | 42.9 | 42.9 |
| | 4 | 5 | 13.9 | 23.8 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In16**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 4 | 11.1 | 19.0 | 28.6 |
| | 3 | 10 | 27.8 | 47.6 | 76.2 |
| | 4 | 3 | 8.3 | 14.3 | 90.5 |
| | 5 | 2 | 5.6 | 9.5 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In17**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 2 | 5.6 | 9.5 | 9.5 |
| | 3 | 4 | 11.1 | 19.0 | 28.6 |
| | 4 | 7 | 19.4 | 33.3 | 61.9 |
| | 5 | 8 | 22.2 | 38.1 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In18**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 9 | 25.0 | 42.9 | 52.4 |
| | 3 | 5 | 13.9 | 23.8 | 76.2 |
| | 4 | 4 | 11.1 | 19.0 | 95.2 |
| | 5 | 1 | 2.8 | 4.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In19**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 | 1 | 2.8 | 4.8 | 4.8 |
| | 3 | 2 | 5.6 | 9.5 | 14.3 |
| | 4 | 11 | 30.6 | 52.4 | 66.7 |
| | 5 | 7 | 19.4 | 33.3 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

**In20**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 2 | 5.6 | 9.5 | 9.5 |
| | 2 | 6 | 16.7 | 28.6 | 38.1 |
| | 3 | 8 | 22.2 | 38.1 | 76.2 |
| | 4 | 5 | 13.9 | 23.8 | 100.0 |
| | Total | 21 | 58.3 | 100.0 | |
| Missing | System | 15 | 41.7 | | |
| Total | | 36 | 100.0 | | |

# Appendix F: Inferential statistics

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| d1 | 1.00 | 12 | 20.50 | 246.00 |
| | 2.00 | 24 | 17.50 | 420.00 |
| | Total | 36 | | |
| d2 | 1.00 | 12 | 19.71 | 236.50 |
| | 2.00 | 24 | 17.90 | 429.50 |
| | Total | 36 | | |
| d3 | 1.00 | 12 | 20.71 | 248.50 |
| | 2.00 | 24 | 17.40 | 417.50 |
| | Total | 36 | | |
| d4 | 1.00 | 12 | 17.00 | 204.00 |
| | 2.00 | 24 | 19.25 | 462.00 |
| | Total | 36 | | |
| d5 | 1.00 | 12 | 23.58 | 283.00 |
| | 2.00 | 24 | 15.96 | 383.00 |
| | Total | 36 | | |
| d6 | 1.00 | 12 | 17.79 | 213.50 |
| | 2.00 | 24 | 18.85 | 452.50 |
| | Total | 36 | | |
| d7 | 1.00 | 12 | 18.25 | 219.00 |
| | 2.00 | 24 | 18.63 | 447.00 |
| | Total | 36 | | |
| d8 | 1.00 | 12 | 19.33 | 232.00 |
| | 2.00 | 24 | 18.08 | 434.00 |
| | Total | 36 | | |
| d9 | 1.00 | 12 | 18.83 | 226.00 |
| | 2.00 | 24 | 18.33 | 440.00 |
| | Total | 36 | | |
| d10 | 1.00 | 12 | 18.00 | 216.00 |
| | 2.00 | 24 | 18.75 | 450.00 |
| | Total | 36 | | |
| d11 | 1.00 | 12 | 17.63 | 211.50 |
| | 2.00 | 24 | 18.94 | 454.50 |
| | Total | 36 | | |
| d12 | 1.00 | 11 | 20.91 | 230.00 |
| | 2.00 | 24 | 16.67 | 400.00 |
| | Total | 35 | | |
| d13 | 1.00 | 12 | 24.21 | 290.50 |
| | 2.00 | 24 | 15.65 | 375.50 |
| | Total | 36 | | |
| d14 | 1.00 | 12 | 17.21 | 206.50 |
| | 2.00 | 24 | 19.15 | 459.50 |
| | Total | 36 | | |
| d15 | 1.00 | 12 | 19.67 | 236.00 |
| | 2.00 | 24 | 17.92 | 430.00 |
| | Total | 36 | | |
| d16 | 1.00 | 11 | 19.14 | 210.50 |
| | 2.00 | 24 | 17.48 | 419.50 |
| | Total | 35 | | |

| | | | | |
|---|---|---|---|---|
| d17 | 1.00 | 12 | 21.71 | 260.50 |
| | 2.00 | 24 | 16.90 | 405.50 |
| | Total | 36 | | |
| d18 | 1.00 | 12 | 18.75 | 225.00 |
| | 2.00 | 24 | 18.38 | 441.00 |
| | Total | 36 | | |
| d19 | 1.00 | 12 | 20.00 | 240.00 |
| | 2.00 | 24 | 17.75 | 426.00 |
| | Total | 36 | | |
| b1 | 1.00 | 10 | 16.45 | 164.50 |
| | 2.00 | 23 | 17.24 | 396.50 |
| | Total | 33 | | |
| b2 | 1.00 | 10 | 18.90 | 189.00 |
| | 2.00 | 23 | 16.17 | 372.00 |
| | Total | 33 | | |
| b3 | 1.00 | 10 | 18.15 | 181.50 |
| | 2.00 | 23 | 16.50 | 379.50 |
| | Total | 33 | | |
| b4 | 1.00 | 10 | 18.80 | 188.00 |
| | 2.00 | 23 | 16.22 | 373.00 |
| | Total | 33 | | |
| b5 | 1.00 | 10 | 15.50 | 155.00 |
| | 2.00 | 23 | 17.65 | 406.00 |
| | Total | 33 | | |
| b6 | 1.00 | 10 | 20.70 | 207.00 |
| | 2.00 | 23 | 15.39 | 354.00 |
| | Total | 33 | | |
| b7 | 1.00 | 10 | 18.50 | 185.00 |
| | 2.00 | 23 | 16.35 | 376.00 |
| | Total | 33 | | |
| b8 | 1.00 | 10 | 19.85 | 198.50 |
| | 2.00 | 23 | 15.76 | 362.50 |
| | Total | 33 | | |
| b9 | 1.00 | 9 | 20.06 | 180.50 |
| | 2.00 | 23 | 15.11 | 347.50 |
| | Total | 32 | | |
| b10 | 1.00 | 10 | 19.70 | 197.00 |
| | 2.00 | 23 | 15.83 | 364.00 |
| | Total | 33 | | |
| b11 | 1.00 | 10 | 18.00 | 180.00 |
| | 2.00 | 23 | 16.57 | 381.00 |
| | Total | 33 | | |
| b12 | 1.00 | 10 | 19.65 | 196.50 |
| | 2.00 | 23 | 15.85 | 364.50 |
| | Total | 33 | | |
| b13 | 1.00 | 10 | 21.50 | 215.00 |
| | 2.00 | 22 | 14.23 | 313.00 |
| | Total | 32 | | |
| b14 | 1.00 | 10 | 18.15 | 181.50 |
| | 2.00 | 22 | 15.75 | 346.50 |
| | Total | 32 | | |
| b15 | 1.00 | 10 | 20.15 | 201.50 |
| | 2.00 | 22 | 14.84 | 326.50 |
| | Total | 32 | | |

| | | | | |
|---|---|---|---|---|
| b16 | 1.00 | 10 | 19.40 | 194.00 |
| | 2.00 | 22 | 15.18 | 334.00 |
| | Total | 32 | | |
| b17 | 1.00 | 10 | 19.40 | 194.00 |
| | 2.00 | 22 | 15.18 | 334.00 |
| | Total | 32 | | |
| b18 | 1.00 | 10 | 17.95 | 179.50 |
| | 2.00 | 22 | 15.84 | 348.50 |
| | Total | 32 | | |
| b19 | 1.00 | 10 | 19.60 | 196.00 |
| | 2.00 | 22 | 15.09 | 332.00 |
| | Total | 32 | | |
| b20 | 1.00 | 10 | 19.15 | 191.50 |
| | 2.00 | 22 | 15.30 | 336.50 |
| | Total | 32 | | |
| b21 | 1.00 | 10 | 19.40 | 194.00 |
| | 2.00 | 22 | 15.18 | 334.00 |
| | Total | 32 | | |
| ba1 | 1.00 | 8 | 13.75 | 110.00 |
| | 2.00 | 21 | 15.48 | 325.00 |
| | Total | 29 | | |
| ba2 | 1.00 | 8 | 15.06 | 120.50 |
| | 2.00 | 21 | 14.98 | 314.50 |
| | Total | 29 | | |
| ba3 | 1.00 | 8 | 16.31 | 130.50 |
| | 2.00 | 20 | 13.78 | 275.50 |
| | Total | 28 | | |
| ba4 | 1.00 | 8 | 13.69 | 109.50 |
| | 2.00 | 20 | 14.83 | 296.50 |
| | Total | 28 | | |
| ba5 | 1.00 | 8 | 15.50 | 124.00 |
| | 2.00 | 20 | 14.10 | 282.00 |
| | Total | 28 | | |
| ba6 | 1.00 | 8 | 13.63 | 109.00 |
| | 2.00 | 20 | 14.85 | 297.00 |
| | Total | 28 | | |
| ba7 | 1.00 | 8 | 12.19 | 97.50 |
| | 2.00 | 20 | 15.43 | 308.50 |
| | Total | 28 | | |
| ba8 | 1.00 | 8 | 11.88 | 95.00 |
| | 2.00 | 20 | 15.55 | 311.00 |
| | Total | 28 | | |
| ba9 | 1.00 | 8 | 14.00 | 112.00 |
| | 2.00 | 20 | 14.70 | 294.00 |
| | Total | 28 | | |
| ba10 | 1.00 | 8 | 15.56 | 124.50 |
| | 2.00 | 20 | 14.08 | 281.50 |
| | Total | 28 | | |
| ba11 | 1.00 | 8 | 14.25 | 114.00 |
| | 2.00 | 20 | 14.60 | 292.00 |
| | Total | 28 | | |
| ba12 | 1.00 | 8 | 14.00 | 112.00 |
| | 2.00 | 20 | 14.70 | 294.00 |
| | Total | 28 | | |

| | | | | |
|---|---|---|---|---|
| ba13 | 1.00 | 8 | 17.25 | 138.00 |
| | 2.00 | 20 | 13.40 | 268.00 |
| | Total | 28 | | |
| ba14 | 1.00 | 8 | 14.69 | 117.50 |
| | 2.00 | 20 | 14.43 | 288.50 |
| | Total | 28 | | |
| ba15 | 1.00 | 7 | 14.00 | 98.00 |
| | 2.00 | 20 | 14.00 | 280.00 |
| | Total | 27 | | |
| ba16 | 1.00 | 8 | 13.38 | 107.00 |
| | 2.00 | 20 | 14.95 | 299.00 |
| | Total | 28 | | |
| ba17 | 1.00 | 8 | 15.50 | 124.00 |
| | 2.00 | 20 | 14.10 | 282.00 |
| | Total | 28 | | |
| ba18 | 1.00 | 8 | 14.69 | 117.50 |
| | 2.00 | 20 | 14.43 | 288.50 |
| | Total | 28 | | |
| ba19 | 1.00 | 8 | 13.88 | 111.00 |
| | 2.00 | 20 | 14.75 | 295.00 |
| | Total | 28 | | |
| ba20 | 1.00 | 8 | 14.38 | 115.00 |
| | 2.00 | 20 | 14.55 | 291.00 |
| | Total | 28 | | |

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| St1 | 1.00 | 6 | 10.67 | 64.00 |
| | 2.00 | 17 | 12.47 | 212.00 |
| | Total | 23 | | |
| St3 | 1.00 | 6 | 13.83 | 83.00 |
| | 2.00 | 17 | 11.35 | 193.00 |
| | Total | 23 | | |
| St5 | 1.00 | 6 | 13.75 | 82.50 |
| | 2.00 | 16 | 10.66 | 170.50 |
| | Total | 22 | | |
| St7 | 1.00 | 6 | 15.42 | 92.50 |
| | 2.00 | 17 | 10.79 | 183.50 |
| | Total | 23 | | |
| St9 | 1.00 | 6 | 11.08 | 66.50 |
| | 2.00 | 17 | 12.32 | 209.50 |
| | Total | 23 | | |
| St11 | 1.00 | 6 | 10.17 | 61.00 |
| | 2.00 | 17 | 12.65 | 215.00 |
| | Total | 23 | | |
| St13 | 1.00 | 6 | 9.33 | 56.00 |
| | 2.00 | 17 | 12.94 | 220.00 |
| | Total | 23 | | |
| St15 | 1.00 | 6 | 12.33 | 74.00 |
| | 2.00 | 17 | 11.88 | 202.00 |
| | Total | 23 | | |
| St17 | 1.00 | 6 | 10.92 | 65.50 |
| | 2.00 | 17 | 12.38 | 210.50 |
| | Total | 23 | | |

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Ta1 | 1.00 | 6 | 7.08 | 42.50 |
| | 2.00 | 17 | 13.74 | 233.50 |
| | Total | 23 | | |
| Ta3 | 1.00 | 6 | 11.00 | 66.00 |
| | 2.00 | 17 | 12.35 | 210.00 |
| | Total | 23 | | |
| Ta5 | 1.00 | 6 | 12.00 | 72.00 |
| | 2.00 | 17 | 12.00 | 204.00 |
| | Total | 23 | | |
| Ta7 | 1.00 | 6 | 11.67 | 70.00 |
| | 2.00 | 17 | 12.12 | 206.00 |
| | Total | 23 | | |
| Ta9 | 1.00 | 6 | 10.92 | 65.50 |
| | 2.00 | 17 | 12.38 | 210.50 |
| | Total | 23 | | |
| Ta11 | 1.00 | 6 | 9.83 | 59.00 |
| | 2.00 | 17 | 12.76 | 217.00 |
| | Total | 23 | | |
| Ta13 | 1.00 | 6 | 7.17 | 43.00 |
| | 2.00 | 17 | 13.71 | 233.00 |
| | Total | 23 | | |
| Ta15 | 1.00 | 6 | 9.00 | 54.00 |
| | 2.00 | 17 | 13.06 | 222.00 |
| | Total | 23 | | |
| Ta17 | 1.00 | 6 | 12.00 | 72.00 |
| | 2.00 | 17 | 12.00 | 204.00 |
| | Total | 23 | | |

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Op1 | 1.00 | 6 | 14.25 | 85.50 |
| | 2.00 | 17 | 11.21 | 190.50 |
| | Total | 23 | | |
| Op3 | 1.00 | 6 | 12.83 | 77.00 |
| | 2.00 | 17 | 11.71 | 199.00 |
| | Total | 23 | | |
| Op5 | 1.00 | 6 | 11.00 | 66.00 |
| | 2.00 | 17 | 12.35 | 210.00 |
| | Total | 23 | | |
| Op7 | 1.00 | 6 | 16.25 | 97.50 |
| | 2.00 | 17 | 10.50 | 178.50 |
| | Total | 23 | | |
| Op9 | 1.00 | 6 | 13.33 | 80.00 |
| | 2.00 | 17 | 11.53 | 196.00 |
| | Total | 23 | | |
| Op11 | 1.00 | 6 | 11.33 | 68.00 |
| | 2.00 | 17 | 12.24 | 208.00 |
| | Total | 23 | | |
| Op13 | 1.00 | 6 | 8.92 | 53.50 |
| | 2.00 | 17 | 13.09 | 222.50 |

| | | | | |
|---|---|---|---|---|
| | Total | 23 | | |
| Op15 | 1.00 | 6 | 11.92 | 71.50 |
| | 2.00 | 17 | 12.03 | 204.50 |
| | Total | 23 | | |
| Op17 | 1.00 | 6 | 10.00 | 60.00 |
| | 2.00 | 17 | 12.71 | 216.00 |
| | Total | 23 | | |
| Op19 | 1.00 | 6 | 10.83 | 65.00 |
| | 2.00 | 17 | 12.41 | 211.00 |
| | Total | 23 | | |
| Op21 | 1.00 | 6 | 10.50 | 63.00 |
| | 2.00 | 17 | 12.53 | 213.00 |
| | Total | 23 | | |

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Or1 | 1.00 | 6 | 11.83 | 71.00 |
| | 2.00 | 15 | 10.67 | 160.00 |
| | Total | 21 | | |
| Or3 | 1.00 | 6 | 11.83 | 71.00 |
| | 2.00 | 15 | 10.67 | 160.00 |
| | Total | 21 | | |
| Or5 | 1.00 | 6 | 8.42 | 50.50 |
| | 2.00 | 15 | 12.03 | 180.50 |
| | Total | 21 | | |
| Or7 | 1.00 | 6 | 10.83 | 65.00 |
| | 2.00 | 15 | 11.07 | 166.00 |
| | Total | 21 | | |
| Or9 | 1.00 | 6 | 13.42 | 80.50 |
| | 2.00 | 15 | 10.03 | 150.50 |
| | Total | 21 | | |
| Or11 | 1.00 | 6 | 12.25 | 73.50 |
| | 2.00 | 15 | 10.50 | 157.50 |
| | Total | 21 | | |
| Or13 | 1.00 | 6 | 11.17 | 67.00 |
| | 2.00 | 15 | 10.93 | 164.00 |
| | Total | 21 | | |
| Or15 | 1.00 | 6 | 13.00 | 78.00 |
| | 2.00 | 15 | 10.20 | 153.00 |
| | Total | 21 | | |
| Or17 | 1.00 | 6 | 9.67 | 58.00 |
| | 2.00 | 15 | 11.53 | 173.00 |
| | Total | 21 | | |
| Or19 | 1.00 | 6 | 14.83 | 89.00 |
| | 2.00 | 15 | 9.47 | 142.00 |
| | Total | 21 | | |
| Or21 | 1.00 | 6 | 10.17 | 61.00 |
| | 2.00 | 15 | 11.33 | 170.00 |
| | Total | 21 | | |
| Or23 | 1.00 | 6 | 8.50 | 51.00 |
| | 2.00 | 15 | 12.00 | 180.00 |
| | Total | 21 | | |

| | | | | |
|---|---|---|---|---|
| Or25 | 1.00 | 6 | 10.67 | 64.00 |
| | 2.00 | 15 | 11.13 | 167.00 |
| | Total | 21 | | |
| Or27 | 1.00 | 6 | 9.33 | 56.00 |
| | 2.00 | 15 | 11.67 | 175.00 |
| | Total | 21 | | |
| Or29 | 1.00 | 6 | 9.17 | 55.00 |
| | 2.00 | 15 | 11.73 | 176.00 |
| | Total | 21 | | |
| Or31 | 1.00 | 6 | 11.25 | 67.50 |
| | 2.00 | 15 | 10.90 | 163.50 |
| | Total | 21 | | |

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Te1 | 1.00 | 6 | 8.92 | 53.50 |
| | 2.00 | 15 | 11.83 | 177.50 |
| | Total | 21 | | |
| Te3 | 1.00 | 6 | 7.42 | 44.50 |
| | 2.00 | 15 | 12.43 | 186.50 |
| | Total | 21 | | |
| Te5 | 1.00 | 6 | 10.67 | 64.00 |
| | 2.00 | 15 | 11.13 | 167.00 |
| | Total | 21 | | |
| Te7 | 1.00 | 6 | 10.33 | 62.00 |
| | 2.00 | 15 | 11.27 | 169.00 |
| | Total | 21 | | |
| Te9 | 1.00 | 6 | 13.00 | 78.00 |
| | 2.00 | 15 | 10.20 | 153.00 |
| | Total | 21 | | |
| Te11 | 1.00 | 6 | 11.17 | 67.00 |
| | 2.00 | 15 | 10.93 | 164.00 |
| | Total | 21 | | |
| Te13 | 1.00 | 6 | 11.25 | 67.50 |
| | 2.00 | 15 | 10.90 | 163.50 |
| | Total | 21 | | |
| Te15 | 1.00 | 6 | 10.92 | 65.50 |
| | 2.00 | 15 | 11.03 | 165.50 |
| | Total | 21 | | |
| Te17 | 1.00 | 6 | 7.33 | 44.00 |
| | 2.00 | 15 | 12.47 | 187.00 |
| | Total | 21 | | |
| Te19 | 1.00 | 6 | 8.92 | 53.50 |
| | 2.00 | 15 | 11.83 | 177.50 |
| | Total | 21 | | |
| Te21 | 1.00 | 6 | 9.75 | 58.50 |
| | 2.00 | 15 | 11.50 | 172.50 |
| | Total | 21 | | |
| Te23 | 1.00 | 6 | 13.25 | 79.50 |
| | 2.00 | 15 | 10.10 | 151.50 |
| | Total | 21 | | |
| Te25 | 1.00 | 6 | 10.08 | 60.50 |

| | | | | |
|---|---|---|---|---|
| | 2.00 | 15 | 11.37 | 170.50 |
| | Total | 21 | | |
| Te27 | 1.00 | 6 | 10.92 | 65.50 |
| | 2.00 | 15 | 11.03 | 165.50 |
| | Total | 21 | | |
| Te29 | 1.00 | 6 | 11.67 | 70.00 |
| | 2.00 | 15 | 10.73 | 161.00 |
| | Total | 21 | | |
| Te31 | 1.00 | 6 | 9.00 | 54.00 |
| | 2.00 | 15 | 11.80 | 177.00 |
| | Total | 21 | | |
| Te33 | 1.00 | 6 | 9.83 | 59.00 |
| | 2.00 | 15 | 11.47 | 172.00 |
| | Total | 21 | | |

**Ranks**

| | employee_coded | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| In1 | 1.00 | 6 | 12.33 | 74.00 |
| | 2.00 | 15 | 10.47 | 157.00 |
| | Total | 21 | | |
| In3 | 1.00 | 6 | 12.50 | 75.00 |
| | 2.00 | 15 | 10.40 | 156.00 |
| | Total | 21 | | |
| In5 | 1.00 | 6 | 12.50 | 75.00 |
| | 2.00 | 15 | 10.40 | 156.00 |
| | Total | 21 | | |
| In7 | 1.00 | 6 | 13.50 | 81.00 |
| | 2.00 | 15 | 10.00 | 150.00 |
| | Total | 21 | | |
| In9 | 1.00 | 6 | 12.25 | 73.50 |
| | 2.00 | 15 | 10.50 | 157.50 |
| | Total | 21 | | |
| In11 | 1.00 | 6 | 13.00 | 78.00 |
| | 2.00 | 15 | 10.20 | 153.00 |
| | Total | 21 | | |
| In13 | 1.00 | 6 | 13.33 | 80.00 |
| | 2.00 | 15 | 10.07 | 151.00 |
| | Total | 21 | | |
| In15 | 1.00 | 6 | 11.83 | 71.00 |
| | 2.00 | 15 | 10.67 | 160.00 |
| | Total | 21 | | |
| In17 | 1.00 | 6 | 9.42 | 56.50 |
| | 2.00 | 15 | 11.63 | 174.50 |
| | Total | 21 | | |
| In19 | 1.00 | 6 | 9.42 | 56.50 |
| | 2.00 | 15 | 11.63 | 174.50 |
| | Total | 21 | | |