UNIVERSITEIT VAN PRETORIA
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Research Submission:

Quantifying the impact of green supply chain management: A South African case study

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October 2016

Executive Summary

South African supply chains have moved from basic survival mode to a focus on optimised supply chains. These focus mainly on a reduction of inventory, cost, and lead time. The further shift to end-to-end supply chain visibility might be required to improve customer service and the competitiveness of supply chains (KPMG n.d.).

The World Resources Institute (WRI) reported that, since the Conference of Parties 21 (COP21) in December 2015, six climate change milestones have been met. These milestones are: 2015 being recorded as the warmest year on record; record levels of heat was experienced in each month in 2016; the Arctic Sea ice currently at record low levels; a clearer connection between extreme weather conditions and climate change induced by humans; the impact of carbon-intense behaviour being more serious than predicted; and the Western Artic ice sheet is melting at a faster rate than previously predicted (Gilder, Parker and Rumble 2016).

South Africa's greenhouse gas (GHG) emissions constitute the largest single contribution on the African continent. If carbon emissions (CO_2e) are not reduced, this will continue to grow exponentially. South Africa's emissions are placed in the top twenty in the world when considering per capita emissions. The intensity of the emissions, calculated as the ratio of emission to gross domestic product (GDP), is also above the world average and is similar to that of other industrialised countries globally, such as Japan. The indication is that the South African Parliament will implement a carbon tax from January 2017 (as predicted in April 2016). It is not a question of *whether* a carbon tax will be implemented in South Africa, but *when* (Gilder *et al.* 2016). From the above statements it is clear that there is a need to understand and quantify the impact of implementing environmentally-friendly initiatives on business profitability and sustainability. This would be carried out through a multiple case study approach at a global, South African-based, fast-moving consumer goods (FMCG) company, so that the carbon tax could be minimised and the impact on the environment be reduced. This will be the main objective of the study.

To achieve this, objective, the following secondary objectives must be achieved in order to develop a framework that can be used to quantify the impact of green supply chain initiatives on the profitability and sustainability of a business' supply chain. The developed Green Business Profitability Framework is applied to a South African company's supply chain to determine whether the framework can successfully quantify the impact on environmental and business profitability.

Yin (2014) emphasises that a good research design should address the research objectives or questions, the propositions, and the unit of analysis. The research design should also enable a logical link to the propositions and the criteria that will be used to analyse the results of the case study. This research investigates the difference between environmental management and green supply chain management (GSCM). Subsequently, the history and theories behind GSCM are highlighted. Different decision-making methods for GCSM are identified to address supply chain performance, environmental performance, cost modelling, and performance measures. Existing frameworks of GSCM are also analysed. The research study aims to answer how the impact of implementing environmental initiatives on business profitability and sustainability is best quantified in a South African business. Previous supply chain

research is reviewed, and arranged in an end-to-end supply chain matrix view to understand on which areas of the previous supply chain methods, frameworks, and research to focus.

This research suggests that there is a need to quantify the impact of implementing green supply chain initiatives in a company, based on the profitability and sustainability of that company's supply chain. Existing methods that are used to assess the business profitability and sustainability impacts of initiatives do not focus on monitoring the complete supply chain, from operational activities to longer-term strategic initiatives (Porter and Van der Linde 1999; Schaefer and Kosansky 2008; Marchal *et al.* 2011). In this study, carbon emissions are used as a measure for the impact of sustainability, and are combined with the activity-based costing (ABC) method to understand the impact on profitability as well.

The analytical framework aims to help a company to evaluate the financial and environmental impact of sustainability initiatives, make strategic decisions to improve the business' environmental impact, and to operate in such a way to gain competitive advantage. The end-to-end supply chain view can aid the understanding of GSCM from a wider perspective, and can help the business to be more responsive to, and aware of, the impact of business decisions on its supply chain. The notion of business profitability impact, rather than performance measures, is used to evaluate the supply chain in view of the greater impact business profitability will have on the supply chain.

Relevant case studies were identified and used to determine the impact on the environment and on profitability of implementing initiatives aimed at reducing greenhouse gas (GHG) emissions. The supply chain operations reference model (SCOR) level 1 processes aided in selecting the case studies to ensure that different areas of the supply chain were addressed. The duration of the case studies was one year, because all the peak and off-peak times were included, and because financial performance is reported annually to the business and its shareholders; only then could the full annual impact be assessed.

The developed green business profitability framework uses a combination of existing methods: the value-added analysis (VAA) approach, life cycle assessment (LCA), SCOR, product costing, 'cost to serve', the ABC method, the green supply chain operations reference model (GreenSCOR), and business profitability modelling (BPM). GreenSCOR enabled environmental initiatives to be tracked back to logistics operations, which made it easier to understand and implement. GreenSCOR also helped to link carbon emissions to their source, and to translate green supply chain actions into goals. Cash and Wilkerson (2003) noted that GreenSCOR helps with green management by linking best practices to the detailed processes; and, if it is applied, it can help to reduce carbon emissions. The framework of the South African Department of the Environment, Food, and Rural Affairs (DEFRA) as used to convert the savings into carbon emission savings. The green business profitability framework aims to determine the impact of green supply chain initiatives on business profitability and sustainability.

The case studies addressed different applications of optimisation initiatives, from short-term to longer-term strategic objectives. In the *plan* case study, the framework was applied to determine whether it could be used to solve short-term network planning queries. The *source* area focused on long-term strategy development, while the *make* case study incorporated recommendations from a third party consultant. The *deliver* case study focused on modelling the impact of the current internal initiatives and market trends, while the *return* case study determined the impact caused by operational changes in the case study company. The results from using the green business profitability framework to model short-term strategic planning indicated that the reduction in kilometres travelled obtained by optimising the secondary transportation network was directly related to the total carbon emissions, but not to the increase in business profitability. In the case study, the net effect was reduced carbon emissions and increased business profitability; but it could not be assumed that all the distribution centres (DCs) would show a carbon emission saving. The case study results interpreting the third party consultant's environmental sustainability initiatives indicated that the impact on profitability from implementing the various sustainable manufacturing initiatives was directly related to the carbon emissions, while the savings in lliquefied petroleum gas (LPG) had a bigger impact on profitability but a lower impact on sustainability. The *deliver* case study indicated that the impact on profitability was not directly related to carbon emissions. The daylight harvesting initiative had a bigger impact on carbon emission reduction, but a lower increase in business profitability than the fluorescent lighting initiative. The *return* case study showed that a higher carbon emissions reduction had minimal impact on business profitability.

As South African businesses move from basic supply chains to optimised supply chains under the current economic pressure, business will need to reconsider all options to reduce costs. With the carbon tax legislation looming in 2017, businesses need to become smarter about implementing sustainability initiatives that makes financial sense. The green business profitability framework developed here is a possible tool to consider, as it could help determine the break-even point between environmental sustainability and cost saving.

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List of Abbreviations

ABC	Activity-based costing
AMSA	ArcelorMittal South Africa
ANP	Analytical model
APICS	The American Production and Inventory Control Society
BPM	Business profitability modelling
CDCs	Central distribution centres
CDP	Carbon disclosure project
CH_4	Methane
COGS	Cost of goods sold
CO_2	Carbon dioxide
CO2e	Carbon emissions
COP21	Conference of parties
CP	Cleaner production
CPG	Consumer packaged goods
CSIR	Council for Scientific and Industrial Research
DCs	Distribution centres
DEFRA	Department of Environment, Food, and Rural Affairs
DfE	Design for the Environment
EA	Environmental auditing
ECP	Economic performance
EEGECOST	Environmental Engineering Group environmental costing model
EIA	Energy Information Administration
EMS	Environmental management systems
EPA	US Environmental Protection Agency
EPE	Environmental performance evaluation
ERP	Enterprise resource planning
EUISSCA	Electric Utility Industry Sustainable Supply Chain Alliance
FMCG	Fast-moving consumer goods
GDP	Gross domestic product
GHG	Greenhouse gas
GHGs	Greenhouse gases
GJ	Gigajoule
GP	Gross profit
GP%	Gross profit percentage
GRI	Global reporting initiative
GreenSCOR	Green supply chain operations reference model
GSCM	Green supply chain management
GSV	Gross sales value

GTM	Go to market
GWP	Global warming potential
HFCs	Hydrofluorocarbons
HID	High-intensity discharge
IEMS	Integrated environmental management systems
IRR	Internal rate of return
ISO	International Organization of Standardization
JIT	Just-in-time
KG	Kilogram
$kgCO_2e$	Kilogram carbon emissions
kVa	Kilovolt ampere
kWh	Kilowatt-hour
kW	Kilowatt
KZN	KwaZulu-Natal
LCA	Life cycle assessment
LCC	Life cycle cost
LCIA	Life cycle impact assessment
LCI	Life cycle inventory
LCS	Life cycle screening
LPG	Liquefied petroleum gas
M^3	Cubic meter
MCP	Marginal customer profitability
MET	Material, energy and toxic-analysis
MIPS	Material Input per service unit
MOH	Manufacturing overhead
MV	Megavolts
Nf_3	Nitrogen trifluoride
N_2O	Nitrous oxide
O_2	Oxygen
OBIA	Overall business impact assessment
OP	Operational performance
PFC’s	Perfluorocarbons
PM	Pocket margin
PP	Pocket price
PPV	Price variances
PWC	PriceWaterhouseCoopers
ROE	Return on equity
ROI	Return on investment
rPET	Recycled polyethylene terephthalate
SCC	Supply Chain Council
SCM	Supply chain management

SCOR	Supply chain operations reference model
SCS	JDA supply chain strategist
SF_6	Sulphur hexafluoride
SME's	Small- and medium-sized enterprises
SSA	Sub-Saharan Africa
TCA	Total cost assessment
TPS	Toyota production system
UI	User interface
UN	United Nations
UNEP	United Nations Environment Programme
US	United States
USA	United States of America
VAA	Value-added analysis
VBA	Visual Basic for applications
WBCSD	World Business Council of Sustainable Development
WRI	World Resources Institute

Chapter 1: Introduction

1.1. Background

South African businesses have moved from basic supply chains to optimised supply chains. Optimised supply chains, in contrast to basic supply chains, place significant focus on reducing costs, inventory, and lead times, in addition to enabling more efficient operations to remain competitive in the market. To operate optimised supply chains, the shift to an end-to-end supply chain view in the South African environment might be required in future to adhere better to customer service requirements and remain competitive in their respective markets (Kumar 2013).

Marchal *et al.* (2011) explain that the gross domestic product (GDP) is a country's monetary value measurement of all the goods the country has manufactured in a year. The total value of goods and services rendered are taken into account for the GDP calculation. Based on the assumption that within 50 years the world's population will be 1.5 times greater than the current population, the GDP per capita will increase 3.4 times by 2050. Based on the current figures, the South African population will increase 1.4 times and the GDP per capita 2.1 times. The increase in population will result in an increase in pollution; and so eco-efficiency must also increase proportionally for the world to remain at the same level of environmental impact experienced today (Marchal *et al.* 2011).

Van Hille and Louw (2012) highlight that the South African Minister of Finance, Pravin Gordhan, announced during the 2014 national budget speech that the implementation of carbon emissions tax would most likely begin in 2016, following on from the commitments South Africa made at the 2009 Copenhagen Climate Change talks to reduce carbon emissions. South Africa committed to reduce carbon emissions by 34 per cent in 2020 and 45 per cent in 2025. Van Hille and Louw (2015) add that this could only be achieved if all the private companies and government institutions in South Africa actively worked together to reduce carbon emissions. Companies such as Sasol and ArcelorMittal South Africa (AMSA) have said that the new carbon emissions regulations will only erode profit further, as they already have to deal with rising electricity prices and slow economic growth (*Business Day Live* (n.d.)).The Carbon Report (n.d.) highlights that the predicted cost for a ton of carbon emissions is R120, but that further discounts and thresholds would be put in place that would reduce the cost to between R6 and R48 per ton carbon emissions (CO_2e). Carbon tax excludes the levies that will be charged by Eskom for carbon tax – 3.5c per kilowatt-hour (kWh) – and that brought in R8.8 billion in 2015, and will increase to 5.5c/kWh in 2017. The R8.8 million carbon tax levies earned by Eskom form part of the total levies Eskom will be liable to pay in order to generate electricity.

Greve (2015) states that companies need to plan to accommodate the extra cost of manufacturing, and that this will already be a challenge in the current economic climate. The current carbon emissions legislation forces companies to understand the impact of their supply chain activities and of any cost savings they can obtain through implementing green initiatives. Frost and Sullivan (2015), who conducted the Barloworld supply chain foresight survey, reported that 64 per cent of the surveyed SA-based companies' value enhanced social and environmental sustainability. They add that, of the companies surveyed, 74 per cent view the demand for environmental and green credentials as a major trend and opportunity to adapt their supply chains accordingly, and that there is the potential scope to reduce supply chain costs.

Friedman (2008) argues that a fast-growing population and global warming can cause the world to feel hot and crowded, and that there is limited time to react to the looming climate crisis. Companies therefore need to adopt more energy-efficient practices to reduce their impact on the environment and their contribution to global warming. One way to achieve this is to implement green supply chain initiatives. Srivastava (2007) states that green supply chain management (GSCM) is a combination of supply chain management and environmental management, and that incorporating the green factor into supply chain management requires an understanding of the relationships between supply chain management and the natural environment.

Porter and Van der Linde (1999) comment that properly-designed green supply chain initiatives can lead to cost savings in the context of the total supply chain cost of a product. Thus implementing properly-designed green supply chain initiatives can increase the competitiveness of a company in its markets. However, they also note that leadership mainly focuses on the implementation cost, or static cost, and the cost savings of green initiatives, instead of calculating the net effect of the investment. Taking the cost and savings alone into account only indicates of the cost of making the change, but disregards how the change might impact another part of the supply chain and add or reduce cost. An illustrative example of this is the implementation of environmentally-friendly packaging, which results in fewer units fitting into a case. This in turn means that more cases are handled in the warehouse, creating increased material handling requirements and more delivery trips to the customer, increasing the ‘cost to serve’ to the customer and possibly reducing profitability. Porter and Van der Linde (1999) therefore recommend that the total end-to-end supply chain impact be assessed before implementing an initiative. Schaefer and Kosansky (2008) note that network analysis and design can help companies to find optimal profitability in financially-competitive times. Adding green supply chain initiatives to the approach, they argue, may aid companies to understand how to implement GSCM in a sustainable and profitable way. They add that one way to achieve this is to use the supply chain operations reference model (SCOR) for end-to-end supply chain assessment, and to understand on which part of the supply chain to focus for sustainability and efficiency.

Schaefer and Kosansky (2008) maintain that the SCOR model enables managers to understand how businesses relate to their markets and the possible influence of an activity on the supply chain. They also emphasise the need for any supply chain analysis and improvement method to focus on probability and sustainability simultaneously. The Supply Chain Council (SCC) (n.d.) explains that the SCOR reference model can be used to relate supply chain activities and their performance. They add that the SCOR model connects technology, processes, best practices of processes, and metrics.

The above literature introduces the concept of GSCM, as well as the need for the use of an end-to-end supply chain assessment framework when considering the overall supply chain impact of the implementation of green initiatives. The rationale behind the research study presented in this dissertation is that quantifying the impact of green initiatives on business profitability and sustainability can help to bring about an improved understanding of the effect of green initiatives on the supply chain, which in turn can support strategic decision-making in businesses.

1.2. Research problem

The preliminary research suggests that there is a need to quantify the impact of implementing green supply chain initiatives in a company, based on the profitability and sustainability of that company's supply chain. Existing methods used to assess the business profitability and sustainability impacts of initiatives do not focus on monitoring the complete supply chain, from operational activities to longer-term strategic initiatives. Existing methods focus more on analysing the environmental impact, current legislation, and high-level costs, but do not analyse the impact of sustainability and profitability *together* (Porter and Van der Linde 1999; Schaefer and Kosansky 2008; Marchal *et al.* 2011).

Improving environmental impact performance is a long-term process, and so it is important to ensure that the analytical framework used will drive both strategic and operational decisions. Since few frameworks address both operational and strategic decision-making, a new framework is required to assess the impact of green initiatives on businesses' profitability and sustainability. Thus the research question below will be investigated and answered throughout the research study presented in this dissertation.

How can the impact of implementing environmental initiatives on business profitability and sustainability best be quantified in a South African business?

1.3. Research objectives

The main objective of the research study is to develop an analytical framework to quantify the impact of implementing environmentally-friendly initiatives on business profitability and sustainability in a multiple case study approach at a global, South African-based, fast moving consumer goods (FMCG) company. To achieve this, the following secondary objectives must be achieved:

1. To develop a framework that can be used to quantify the impact of green supply chain initiatives on the profitability and sustainability of a business' supply chain.
2. To apply the framework to a South African company's supply chain, to determine whether the framework can successfully quantify that environmental and business profitability impact.

1.4. Research approach

The research approach incorporates various methods, theories, and best practices to aid in the development of the framework. The analytical framework is aimed at assisting the case study company to evaluate the financial impact of environmental initiatives, make strategic decisions to improve the business' environmental impact, and operate in a way that gives it competitive advantage in its markets.

An FMCG company is also known as a consumer packaged goods (CPG) company (Statista 2015). Product characteristics include low profit, short shelf life, high volume sales, and a life span of less than a year. Familiar categories include personal care items, food and beverages, household items, tobacco, pet care products, and clothing (Statista 2015). According to Investopedia (n.d.), FMCG products are accessible to people in developed and developing countries on a daily basis. They are also found in a sizable marketplace represented by some of the largest companies in the world. Statista (2015) adds that the largest FMCG companies in the world that are rated on net sales in millions of US$ include Nestle, Procter and Gamble, PepsiCo, Unilever, Coca-Cola, AB InBev, JBS, Mondelez, Archer Daniels Midland, and Tyson Foods.

According to Fouché (2012), South Africa has the 20th largest retail market in the world, and leads the international community's changing perceptions of investing in Africa. He predicts that Africa's GDP is expected to swell by 1 trillion US$ by 2020. Statistics South Africa (n.d.) report that retail market sales for 2014 were R707 million, of which 41 per cent were contributed by general dealers, 21 per cent by textile and clothing businesses, and 9 per cent by food and beverages businesses. The remaining 29 per cent were contributed by pharmaceutical, household, hardware, and other businesses.

Fouché (2012) also states that the demand for consumer goods in South Africa was R491.5bn in 2011, and was expected to grow at a rate of 11.5 per cent for the period 2012 to 2016. Kumo, Omilola and Minsat (2015) report that the South African manufacturing industry contributed 13.2 per cent of the GDP at 2014 prices, and that the expected GDP growth for 2015 was 2.0 per cent.

Miles (2014) remarks that Africa's markets offer significant expansion opportunities for FMCG businesses specialising in food and other necessary low-cost supplies, due to the high poverty levels in Sub-Saharan Africa. She adds that South Africa is seen as the gateway into Africa for large FMCG companies. The strategy is to manufacture the products in South Africa and then export them to the rest of Africa, thus investing in the markets before investing in manufacturing infrastructure in Africa. The *Economist* and the International Monetary Fund (n.d.) published a list of the world's top ten fastest-growing economies for 2015. Seven of the countries were in Africa: Ethiopia, Mozambique, Tanzania, Congo, Ghana, Zambia and Nigeria. The *Economist* and the International Monetary Fund (n.d.) have predicted that Sub-Saharan Africa (SSA) would grow by 4.5 per cent in 2015 – a lower rate than in previous years, due to the decline in oil and other commodity prices.

Furthermore, the impact of consumer goods on the environment has been investigated and has been found to be significant. Coad (2014) reports that the worldwide impact of the use of plastics for consumer goods on the environment, measured as natural capital cost, exceeds 75 billion US$ annually. She also highlights the need for businesses to manage and report on the use of plastics to manage costs and manufacture more sustainable products. Locally, topics to do with the environmental impact of FMCGs have been investigated in various forms. Du Toit (2011) indicates how various aspects of sustainability related to FMCG products impact customer behaviour, and specifically how 'green' labelling influences consumer decisions. Consumers are placing more pressure on businesses for environmentally-sustainable practices; and this might influence buying behaviour. According to Van Hille and Louw (2012), the major South African retailers have stated that the introduction of carbon tax could have a R100 million annual impact on their costs. They add that companies are introducing initiatives to reduce electricity usage, fuel usage, and infrastructure costs. They also note that South African retailers have identified three opportunities to make the best use of packaging: recyclability, incorporating recycled content into current packaging, and light weighting. Woolworths South Africa committed to having 100 per cent of their packaging using recyclables by

2015. Pick and Pay and Woolworths have also introduced an initiative called 'rPET' (recycled polyethylene terephthalate) which is the inclusion of rPET into their packaging.

The aspects discussed above show how the FMCG industry and its impact on the environment is a topic that is both current and locally relevant. It would therefore be a suitable industry to be the focus for multiple case studies at a single FMCG company. The research reported above also highlights the growth opportunities for companies in Africa, making it a promising continent for investment. This study, therefore, will focus on a large FMCG company in South Africa that also exports significant volumes to other African countries. This company is one of the top ten largest FMCG businesses in the world, and has aggressive growth targets. With the implementation of carbon tax looming, there is a need for the case study company to understand the impact of green initiatives on business profitability and sustainability. The framework will be tested in this business that operates in the food and beverage market.

This will be achieved through a series of case studies to quantify the impact of implementing environmentally-friendly initiatives on business profitability and sustainability at a selected company. The developed framework will be tested at a strategic level and at the lowest detail activity level, to investigate whether the framework can successfully quantify the environmental and business profitability impact.

1.5. Research methodology

1.5.1 Research strategies

To address the research question, a suitable strategy is needed that focuses on current events and addresses the research question – that is, how the impact of implementing environmental initiatives on business profitability and sustainability can best be quantified in a South African business. Yin (2014) states that there are three conditions that distinguish different research strategies from one another. These are: the type of research question, the control over events, and the focus on historical or current events. Yin (2014) adds that five types of strategies can be applied to research studies: experiment, survey, archival analysis, history, and case study. Similarly, there are five types of research questions: 'who', 'what', 'where', 'how', and 'why'. Table 1 summarises the conditions, the five types of research study, and the research questions.

Table 1: Different research strategies summarised for different situations (Adapted from Yin 2014)

Strategy	Form of research question	Requires control over behavioural events?	Focuses on contemporary events?
Experiment	How, Why	Yes	Yes
Survey	Who, What, Where, How many, How much	No	Yes
Archival analysis	Who, What, Where, How many, How much	No	Yes/No
History	How, Why	No	No
Case study	How Why	No	Yes

The experimental, history, and case study research studies apply to 'how' and 'why' structured research questions. These questions are more explanatory, and involve the investigation of an operational environment over time rather than tracking a single occurrence or event. The difference between the experimental, historical, and case study strategies is determined by the control that the researcher needs to have over the study. The experimental strategy occurs in a laboratory; and this is applicable when the researcher has direct control, manipulating behaviour in a controlled and isolated environment. The historical strategy is preferred when no access or control is required; the study deals with the 'dead' past. The researcher will rely on historical information as a source of evidence. When the historical strategy deals with current events, then it becomes a case study strategy – the preferred research strategy when examining current events. A case study includes the same techniques as the historical strategy, but it also includes direct observation and interviewing. The case study strategy will be the best one to use when investigating a current event over which there is little or no control. The 'what', 'where', 'how much', and 'how many' questions are either about widespread presence or explanatory questions. In the case of the widespread presence, surveys or archival analysis are the recommended strategies, as both are appropriate when the research goal is to describe an occurrence or to predict a particular outcome (Yin 2014).

Gulsecen and Kubat (2006) comment that the case study research method is best for understanding difficult problems, and is mostly used when in-depth research is required. The case study method must show that it is appropriate to answering the research question, that the proper guidelines are followed, and that there is enough evidence to come to an accurate conclusion. In-depth research is required to quantify the impact of environmental initiatives on business profitability and sustainability due to the detailed kind of financial data that is required, and to ensure that enough evidence is considered for an accurate conclusion. Various green supply chain methods will be evaluated for their suitability for use in a series of case studies in different sections of the supply chain at the case study company.

In addition, Zainal (2007) notes that it is important to prove that the case study approach is the only way to obtain reliable data from the source in the light of the research question. The quantitative proof of the analytical framework is methodically recorded, and the backbone of the case study is a theoretical framework. A theoretical framework will be developed, and – because of the level of input data required for the framework – the case study approach will allow reliable data collection: actual financial data will serve as quantitative proof of the outcome, by comparing it with the original set of values. The financial statements will provide detailed level general ledger and actual expense data. Because of the high granularity of this data, a case study will be the most suitable method to answer the research question. To ensure a methodical approach, the supply chain will be assessed in terms of the SCOR model top level processes: *plan, make, source, deliver, enable,* and *return*.

The use of a case study research strategy will allow for the problem to be understood in great detail – something that is necessary when dealing with financial data and when working in the natural setting to understand the full impact on the end-to-end supply chain (Gulsecen and Kubat 2006; Zainal 2007).

Seuring (2008) adds that case studies can be useful when analysing a problem in its natural setting, because they make it possible to carry out direct observation. Thus the case study method was used at the selected FMCG company to perform multiple case studies – given that the application of a single case study is beneficial when it is representative of a critical example, represents a larger group, is exclusive, and can be a trial for multi-case study research in the future (Seuring 2008). The proposed series of case studies at the case study company will be indicative of one of the major role players in the FMCG industry, and the analytical framework applied to it will be built in a generic fashion. The study will allow the framework to be applied to multiple case studies at other companies for future research. The generic fashion of the framework will allow the company to select the level at which they want to analyse, and is dependent on the amount of data they have available and what section of the supply chain they want to analyse. The model allows for different views of the financial data to be included in it, and it is flexible enough to calculate the environmental impact of initiatives. This will allow a company to track the impact of green supply chain initiatives, and not simply to implement them.

The case study strategy will be the most suitable approach to answering the 'how' and 'why' questions, which link back to the objectives of the study. The 'what' question (quantifying the impact of green supply chain initiatives on profitability) and the 'how' question (determining the suitability of the framework in a South African business) imply an environment over which the researcher has little or no control, and address a contemporary event that cannot be manipulated. The data collection will also be partly historical, partly direct observation of the case study environment.

1.5.2 Validity and reliability

Gulsecen and Kubat (2006) add that the case study method as a powerful research tool receives the most criticism, and that a case study must be planned in great detail to ensure success. The disadvantage of a single case study approach, they say, is that it lacks generalisable results. To overcome this, they suggest that case studies be tested many times through the application of different methods. The value and validity of the framework developed here will be analysed through a series of case studies at the case study company, to address the various validity and reliability tests summarised below.

Yin (2014) summarises the tests and tactics that would ensure the validity and reliability of a case study (Table 2). A research study needs to represent a logical set of statements; and their quality can be judged by applying certain logical tests. To ensure the validity and reliability of a case study, four tests can be applied: construct validity, internal validity, external validity, and reliability. Construct validity includes ensuring that a fixed set of operational data are used to collect data, and that subjective judgments are used to collect the data. Construct validity tactics include the use of multiple sources of evidence, establishing a chain of evidence, and verifying the case study results with key informants.

Yin (2014) says that internal validity is only applicable in causal studies that involve the investigator making incorrect assumptions about the correlation between variables. To ensure external validity, the applicable tactics include pattern matching, explanation building, and time series analysis. External validity establishes the domain to which the case study results can be generalised. To avoid generalising the findings of the case study beyond its immediate domain, replication logic can be used in multiple case studies. External validity occurs in the research design phase, and the researcher needs to ensure that the domain is clearly defined. In this study, the domain will be the South African-based FMCG company in which multiple case studies will be performed and from which results can be generalised.

'Reliability' refers to following a methodology for data collection and framework application that can be repeated with the same results. The test for reliability will be that a researcher applies the same data collection and application processes, and they have the same findings and conclusions. To ensure reliability, the steps of the case study must be documented in detail. Reliability can be assured by using a case study protocol and developing a case study database. To ensure reliability, the research must be conducted such that it can be audited by the case study company at any time.

Table 2: Case study tactics for four design tests (Adapted from Yin 2014)

Tests	Case study tactic	Phase of research in which tactic occurs
Construct Validity	1. Use multiple sources of evidence	Data collection
	2. Establish chain of evidence	Data collection
	3. Have key informants review draft case study report	Composition
Internal validity	1. Do pattern matching	Data analysis
	2. Do explanation building	Data analysis
	3. Do time series analysis	Data analysis
External Validity	1. Use replication logic in multiple case studies	Research design
Reliability	1. Use case study protocol	Data collection
	2. Develop case study database	Data collection

To ensure validity and reliability in the application of the case study, the following tactics will be applied:

- To ensure construct validity, the case study will include multiple sources of evidence, partly from historical data and partly from direct observation.
- The data that will be used can be referred back to current processes and company records to establish a chain of evidence for construct validity.
- For construct validity, the case study company will also sign off the study's results, and the key informants will review the draft case study report to ensure the validity of the data and that the recommended findings are practical to implement.
- To ensure external validity, replication logic will be applied to the multiple case studies by ensuring that the same framework and analytical steps are followed to implement the designed framework in different sections of the supply chain.
- Reliability will be ensured by recording the detailed steps taken in conducting the case study, to ensure that it can be repeated and yield the same results.

The framework will be developed using previous research, the application of other frameworks, and case studies. The developed framework will be applied to a series of cases studies in different parts of the case study company's supply chain. Building the theory will be the largest part of the method, followed by testing the theory and application research. Theory-building includes the academic research; summarising it in an end-to-end supply chain matrix view; using the existing literature; highlighting which parts of the supply chain are addressed by existing frameworks; the specific industry focus of the case studies; and the applied research methodologies. The theory-testing and application research will be done by applying the framework to multiple case studies at a single case study company. The baseline (actual) will be compared with the different scenarios to understand the full impact of green supply chain initiatives. The details of the design will be discussed in Chapter 3.

1.6. Expected contributions

The deliverables of the project can assist the case study company to understand the financial and sustainability impact of their green supply chain initiatives, and to identify which factors to consider before implementing such initiatives. It can also serve as a trial for other case studies in which the framework could be used in other companies and industries (Seuring 2008).

The researcher's contribution to the scientific knowledge base will be in the form of an analytical framework that can enable FMCG companies to evaluate and quantify the financial and sustainability impact of their green initiatives. The project can also serve as the basis for future research in other projects that evaluate the financial and sustainability impact of environmentally-friendly initiatives. To the author's knowledge, this will be the first end-to-end Green Supply Chain case study analysing the impact of GSCM on profitability and sustainability in a South African company.

1.7. Limitations and assumptions of the study

The scope of the study was limited to one South African FMCG company in order to be able to study this company in some depth, and to determine whether the framework could be a suitable solution for quantifying GSCM in a business. Therefore, not all main role players in the FMCG industry in South Africa were analysed; and the study should not be used to derive industry trends. However, it serves as a good starting point for similar studies in the future.

It should be noted that a confidentiality agreement was entered into with the case study company; thus any financial information, monetary amounts, or customer information may not be published. Although financial values similar to the company's actual financial values had to be substituted in reporting the case study results in the document, the relationship between the values remains unchanged so that they reflect the true results of implementing the green business profitability framework. The actual values will be used to establish the reliability and validity of the study and to audit the results; but they cannot be published in this report.

1.8. Document structure

Chapter 2 provides a detailed study of current methods, models, and approaches to quantifying GSCM, and of the latest developments in GSCM. Chapter 3 focuses on the framework design, and investigates theories, models, and methods to use during the development of the framework. A description of the framework design process and the proposed framework itself are presented in this chapter. Chapter 4 summarises the data-gathering process, the analysis, the identification of key performance indicators, testing of the framework, and the results of the case studies at the case study company. The final chapter summarises the findings of the study, makes relevant recommendations, and presents future opportunities arising from the study.

Chapter 2: Literature Review

2.1 Overview

An editorial in the *Mail and Guardian* (2012) asserts that the '*Earth has only one decade to pull back from various environmental tipping points before the damage caused by current consumption and production patterns becomes irreversible'*. The article also summarises the state of resources per country, and how South Africa measures against China, Brazil, and Nigeria in consumption of resources. It is estimated that South Africa emits nine tonnes of carbon emissions per person, compared with China's five tonnes per person and Brazil's two tonnes. South Africa also has the highest energy consumption per capita when compared with China, Brazil, and Nigeria. It is becoming increasingly important, therefore, for South African businesses to determine and manage the environmental impact of their products. The statistics are presented in Figures 1 and 2.

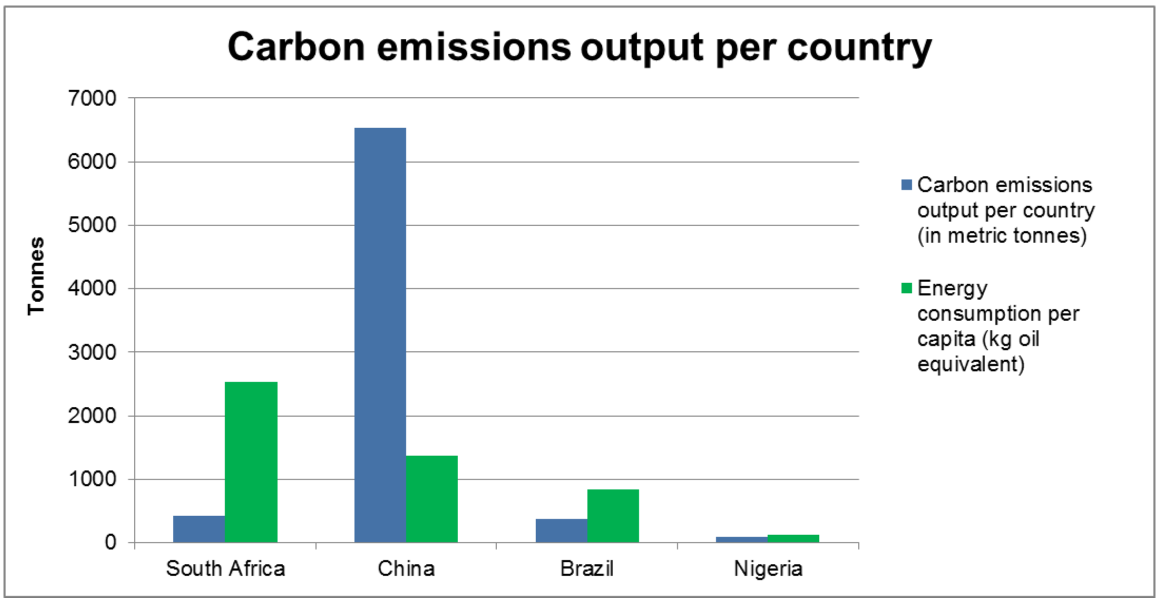


Figure 1: Carbon emission output per country (Adapted from Mail and Guardian 2012)

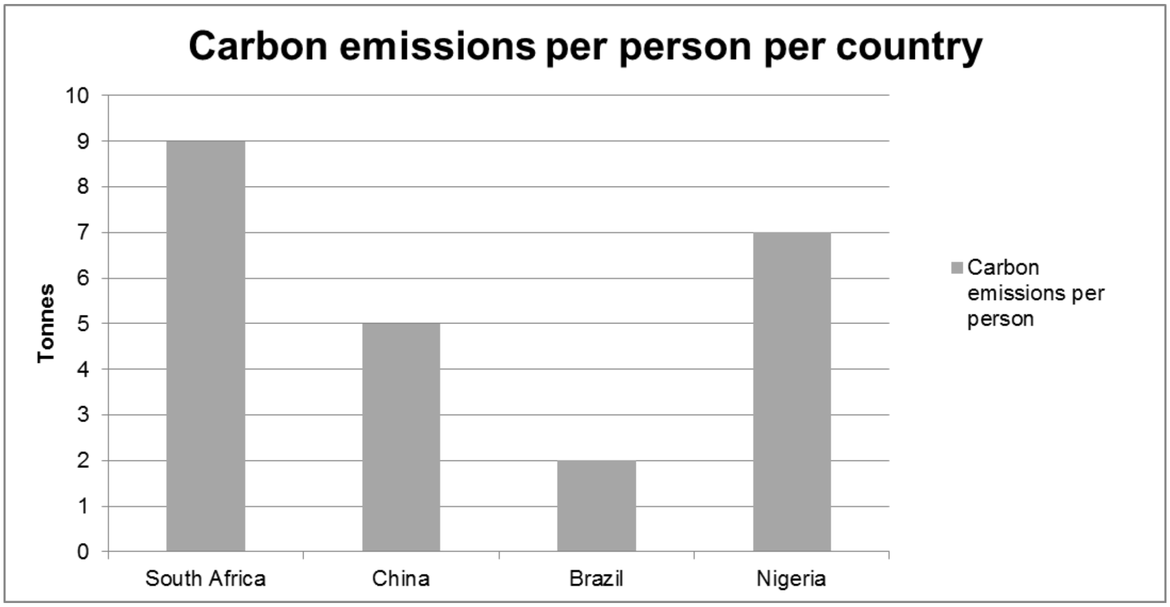


Figure 2: Carbon emissions per person per country (Adapted from Mail and Guardian 2012)

One way to achieve this is to adopt an end-to-end supply chain view, also known as the life cycle assessment (LCA) or the cradle-to-grave approach, to calculate and compare the environmental impact of a product throughout its supply chain (Clift and Wright 2000). Another method for assessing the environmental impact of a business, developed by Unilever, is referred to as the overall business impact assessment (OBIA) model. It is used to determine the impact of environmental factors and the economic value of a product as it moves through the supply chain (Clift and Wright 2000).

Despite the increasing need to measure and manage the environmental impact of businesses and their supply chains, many decision-makers remain hesitant to implement environmental management initiatives. In a study investigating the different ways in which companies can add more value to their supply chains by adding ethical, economic, social, and environmental levers – for example, by manufacturing at a lower cost and sourcing more sustainably – the researchers found that selected managers in large international organisations think that daily operational activities require a high number of resources and time, and that there is limited time for an agenda supporting sustainability (Price Waterhouse Coopers [PWC] and The American Production and Inventory Control Society [APICS] 2013). The study also identifies companies' hesitation about implementing environmentally sustainable solutions due to the uncertainty of the impact. The concern is whether these solutions would in fact result in cost reductions and increased productivity.

In addition, results from a PWC and APICS survey indicate that most of the leaders in the responding companies do not support the drive to implement 'green' supply chain initiatives in their businesses, that the cost savings of green initiatives are not measurable, and that the impact of green initiatives is generally unknown (PWC and APICS 2013). The survey also summarises various factors hampering the success of green initiatives, including that the current performance measures do not allow for green measures; that it is a struggle to motivate green initiatives for investment; and that green initiatives are not part of companies' strategic objectives.

In order to react to the looming climate change crisis, the managers and decision-makers of businesses need to place a greater emphasis on environmental and green supply chain management (GSCM).

Yin (2014) emphasises that a good research design should address the research objectives or questions, the propositions, and the unit of analysis. The research design should also enable the logical linking of the propositions and the criteria that will be used to analyse the results of the case study. Yin (2014) highlights that the main purpose of the case study method is to develop or test theory. Therefore, theory development is essential in the design phase of the case study. To enable this, and to ensure a proper case study, an overview of the structured literature review approach can be viewed in Figure 3. The structured approach can aid in understanding the various areas of GSCM that will be included in the research, and how the research is structured to address the research question.

The differences between environmental management and GSCM are investigated, and then the history and theories behind GSCM are highlighted. Different decision-making methods for GCSM are identified to address supply chain performance, environmental performance, cost modelling, and performance measures. Existing frameworks of GSCM are also analysed to determine whether or not a suitable framework already exists. The research study aims to discover how the impact of implementing environmental initiatives on business profitability and sustainability can best be quantified in a South African business. Previous supply chain research is reviewed and structured in an end-to-end supply chain matrix view in order to understand which areas of the previous supply chain methods, frameworks, and research to focus on.

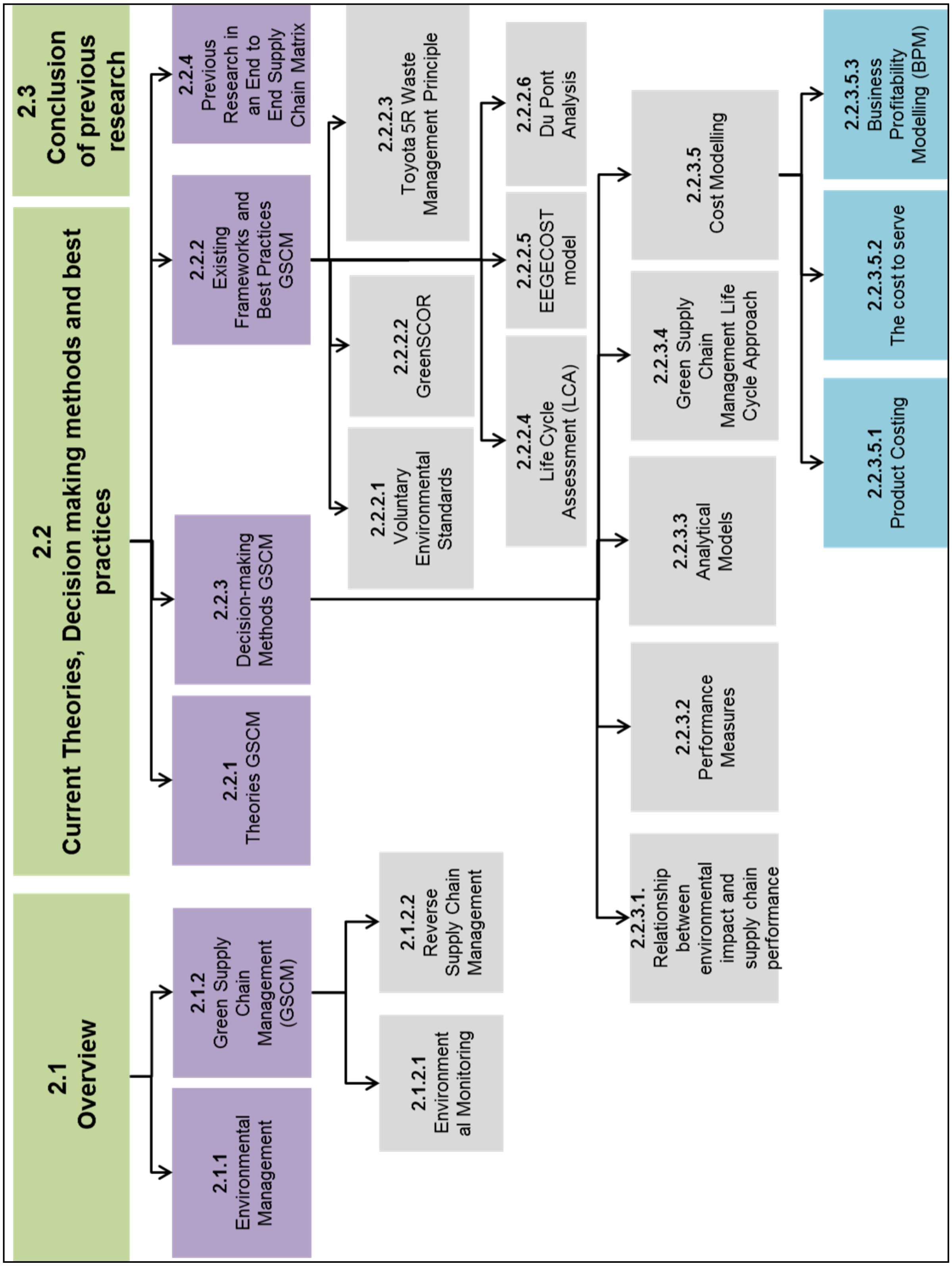


Figure 3: Overview of the literature review

2.1.1 Environmental management

Environmental management is the management of natural resources used for basic human needs by minimising the effect of daily activities on the environment (De Beer and Friend 2006). Since the available natural resources cannot sustain current consumption levels in the long-term, businesses must implement sustainability measures and environmental management initiatives.

Environmental accounting is a new way of understanding the environmental impact of the supply chain. This can be used in conjunction with other environmental management tools, such as International Organisation of Standardisation (ISO) 14001 and Integrated Environmental Management Systems (IEMS), to manage and reduce the environmental impact of businesses (De Beer and Friend 2006).

The benefits of combining environmental accounting and environmental management frameworks in businesses are illustrated in a number of success stories. General Motors reported a $12 million saving by introducing reusable containers; the Andersen Corporation's internal rate of return (IRR) exceeded 50 per cent by investigating and eliminating waste at the source; and Commonwealth Edison introduced more effective resource utilisation and realised a $25 million saving as a result (De Beer and Friend 2006).

When implementing environmental management approaches in the business environment, it is important to distinguish between internal and external environmental costs (De Beer and Friend 2006). Internal costs consist of day-to-day operational, conditional, or hidden costs, where operational costs are running costs, such as raw material and equipment costs; conditional costs are future-based costs; and hidden costs are any other unexpected costs. Conversely, external costs are costs outside the firm for which the firm is not liable.

Many approaches or tools can be used to measure and manage the impact of business on the environment. These include Cleaner Production (CP) (United Nations Environment Programme (UNEP) n.d.), LCA (ISO n.d.), Life Cycle Screening (LCS) (Brezet 1995), Life Cycle Cost (LCC) (U.S. Department of Defense n.d.), Material, Energy and Toxic-Analysis (MET) (U.S. Environmental Protection Agency [EPA] 1992), Material Input per Service Unit (MIPS) (Liedtke 1994), Design for the Environment (DfE) (U.S. EPA 1992), Environmental Auditing (EA) (U.S. EPA 1992), Environmental Performance Evaluation (EPE) (ISO n.d.), and Environmental Management Systems (EMS) (U.S. EPA 1992) (Magerholm Fet 2002).

Magerholm Fet (2002) reports that the CP method works on the same principles as the EPE. The process involves an initial investigation to identify optimisation opportunities in reducing or eliminating waste. The findings are then used to determine which areas to prioritise. This methodology includes the development of a detailed pollution prevention framework and how to apply it, and provides guidelines for recycling and cost-effective alternatives that will minimise pollution. A limitation of the tool is that it does not include any studies assessing the impact on the environment.

LCA is a method standardised by the ISO, an organisation that develops and publishes international standards for European countries (Magerholm Fet 2002; Evans 2008). LCA is the most wide-ranging method commonly used to assess and incorporate environmental impact into the supply chain, and allows decision-makers to arrive at conclusions about the impact of environmental initiatives on the product's life cycle.

LCS is a method that focuses on the key areas for future investigation, and can be seen as a simplified version of the LCA (Magerholm Fet 2002).

The MET matrix is used to identify environmental contributors such as material cycle, energy consumption, and toxic emissions (Magerholm Fet 2002).

According to Ellis (2007), the LCC model is a cost examination tool that evaluates the total cost of ownership, and does not include environmental issues. However, with the aid of value-added analysis (VAA), the environmental issues associated with the cost of activities can be determined; and this helps with the evaluation of products from an ecological and economic point of view.

Magerholm Fet (2002) describes the MIPS model as a life cycle tool that analyses the material required per product manufactured. By using the number of products that are manufactured and the material and energy input, the material intensity of a product is known. The environmental performance is linked to a single product: the more materials that are used to manufacture the product, the harsher the effect on the environment.

DfE can be described as a process to evaluate the list of product design criteria and, where needed, to supplement more environmentally-friendly designs, whereas EA is the process that, using a detailed verification process, verifies whether the environmental objectives of the business conform to the predefined audit criteria of the business in respect of environmental issues.

Finally, EPE is a method used to compare environmental performance against a company in a similar industry for benchmarking purposes; while an EMS forms part of the management system of businesses to monitor and manage the adoption of environmental policies (Magerholm Fet 2002).

Even though the above-mentioned methods and assessments can assist environmental management in a company, applying MET, MIPS and DfE may not be financially prudent because of their extra resource requirements (Magerholm Fet 2002). However, it may be necessary for the application of the standards to make sure the business acquires the desired accreditation.

It was decided to use LCA and VAA as guidelines for the development of the analytical framework developed as part of this study. The main reason for selecting these particular methods is that LCA incorporates the environmental initiatives into a supply chain view, making it possible to understand the environmental aspect of a product's life cycle. In addition, the VAA links environmental issues with the cost of activities. CP focuses on the broader protocols that must be adhered to on an industry level and on product and process levels. It would be ideal to use, but it does not incorporate any environmental aspects into the method. MET, MIPS, LCC, DfE, and LCS focus on measuring the product production process impact. LCS is a simplified version of the LCA, and so for more detail the LCA method should rather be included. The LCC method focuses on the total cost of ownership, and does not include any financial analysis. MET, MIPS, and DfE require a significant amount of data analysis and time, and are not financially viable models to use. These models also focus more on the product's raw material, product design, and manufacturing methods, and do not include the impact on the supply chain. The EA, EPE, and EMS focus more on benchmarking with other industry players and adhering to audit criteria, which will not be suitable for the development of the framework.

2.1.2 Green Supply Chain Management (GSCM)

Sehgal (2009) defines a supply chain as a network of suppliers, distributors, storage facilities, and retailers that participate in the production, delivery, and sale of a product to the customer. A supply chain consists of three main parts: supply, manufacturing, and distribution. First, the supply function focuses on the sourcing of raw materials and all the processes related to the transportation of raw material from the various suppliers to the production site. Second, manufacturing deals with the transformation of raw materials into finished products. Third, distribution includes the processes to ensure that the product reaches the final customer through an organised network of distributors, warehouses, and retailers.

As an example, a typical supply chain for tomato sauce is presented in Figure 4. The supply chain begins with the farmer planting the seeds for the tomatoes and cultivating fresh tomatoes that are packed and transported to the tomato sauce bottling plant. The bottling plant then uses the tomatoes and various other ingredients to manufacture tomato sauce. The finished product is then transported to the retailer's distribution centre from where the retailer will distribute the product to the relevant retailer outlets. The consumer will then purchase the tomato sauce for consumption (Sehgal 2009).

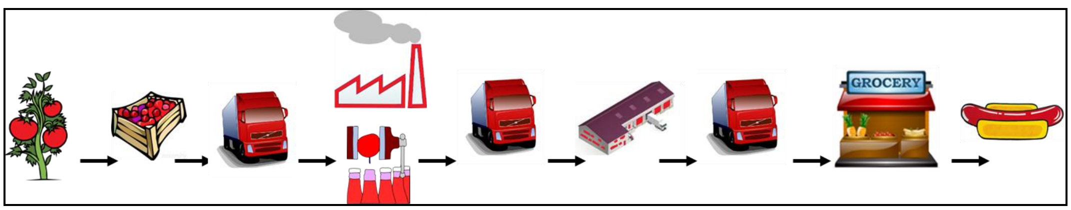


Figure 4: Supply chain for manufacturing tomato sauce (Adapted from Sehgal 2009)

Supply Chain Management (SCM) is the effective management of all the parts of the supply chain, from the raw material planning operations through to selling the products. Strategic SCM focuses on longer-term strategic business decisions, such as outsourcing, infrastructure, and network changes. In contrast, operational SCM will mainly focus on day-to-day operations such as planning delivery schedules, routing, and days of stockholding (Holden 2007).

A supply chain is used to supply, plan, and distribute products across businesses; and contributes a significant part of the carbon footprint of businesses (Sehgal 2009). It is beneficial, therefore, for businesses to work towards environmentally-friendly, or 'green', supply chains. This can be achieved through the process of introducing environmental processes into the end-to-end supply chain, commonly referred to as GSCM (Gillmore 2010). Gillmore (2010) indicates that GSCM was the most popular trend in 2007; thereafter, industry had to place more focus on GSCM and optimisation than ever before.

Charnay, Hoppe and Wen Hsu (2008) comment that the two main reasons for a business to adopt GSCM are to save costs and to lower their environmental impact.

Concerns about global warming have caused many businesses to realise that they must make a contribution to save the environment and preserve the planet. It is important to include GSCM in strategic growth objectives, as this can aid cost savings and increased future profitability. Some additional benefits of GSCM include end-to-end supply chain cost reduction; innovation opportunities in the supply chain; reduction of the environmental impact; risk mitigation; customer service; and sales improvement.

2.2 Current Theories, Decision-making Methods and Best Practices

2.2.1 Green Supply Chain Management (GSCM) Theories

The first environmental LCA was carried out by the Coca-Cola Company in 1969. The findings of the life cycle study highlighted the environmental impact of manufacturing, distribution, and disposal activities in the supply chain. The study formed the basis for more recent studies involving the entire SCM system (Gupta and Wang 2011).

GSCM can be applied in a business to increase profit by saving costs at different stages of the supply chain, while also adhering to environmental regulations (Barari, Agarwal, Zhang, Mahanty and Tiwari 2012). Investing in green production initiatives can lead to higher profits by moving the cost down the supply chain to the customers and selling the product for a higher price. Barari *et al.* (2012) mention a shortcoming in this approach: that the customer will ultimately pay for the cost of going green, and the retailer will most probably need to invest in more marketing initiatives if the consumer is to be persuaded to pay more for the product. With today's price-sensitive market and competing products, producers are reluctant to add to the cost to the consumer, as this would open up the market to competitors.

An industry case study involving the Caterpillar Company shows that investing in more environmentally-friendly business practices results in cost savings and a more sustainable way of doing business. Caterpillar managed to decrease costs by implementing green supply chain initiatives in different areas of the supply chain. Packaging and transportation were areas included in the case study, resulting in an overall savings while contributing to sustainability practices (Brown 2013).

Another industry case study involving Walmart highlights the challenge to improve the return on investment (ROI) for sustainability projects. The need to quantify the financial benefit of implementing green initiatives is emphasised in this study (O'Reily 2013). Jain and Sharma (2014) find that companies experience significant pressure from the government and from customers to adopt GSCM practices. They add that cost reduction and encouraging social responsibility can be a motivation for GSCM. Investors are attracted to manufacturing firms that have adopted GSCM initiatives; and this can have a positive impact on the share value of the company (Bose and Pal 2012).

Kumar, Teichmann and Timpernagel (2011) argue that investing in environmental initiatives at the source of the supply chain – that is, the product design and manufacturing phase – is a more feasible solution than attempting to change and improve the supply chain after the product has been manufactured. They add that implementing lean initiatives is a good starting point for companies that strive to be more profitable and to have sustainable business practices.

The research highlights the fact that it is possible to save costs when implementing green initiatives – and that the savings can motivate the adoption of GSCM. To absorb the cost of GSCM initiatives, it is also possible to pass the cost on to the consumer or to offset it with savings. The consumer will keep on paying more for products; but that is not a feasible solution if the costs cannot be offset. Companies also experience significant pressure from government and customers to implement green initiatives; and the cost of these initiatives can be very high (Barari *et al.* 2012; Bose and Pal 2012; Brown 2013; Jain and Sharma 2014).

The framework presented in this document will focus on quantifying the net impact of the environmental initiatives on the supply chain before it is implemented. The framework will help to ensure that the ROI can be motivated before implementing the initiative. Lean initiatives such as 'reduce' and 'reuse' will also be investigated in the next section.

2.2.2 Existing Frameworks and Best Practices for Green Supply Chain Management (GSCM)

There are many approaches to reduce companies' carbon footprint. According to the World Business Council of Sustainable Development (WBCSD) (n.d.), the areas identified to operate an environmentally-friendly supply chain are: material reduction, energy reduction, use of less toxic materials, improved recyclability, use of renewable resources, increased durability of products, and increased service intensity. The designed framework needs to take these approaches into account. Actions to reduce carbon emissions include using carbon emissions to drive supply chain designs; define carbon emissions as one of the selection criteria for supplier selection; implementing green procurement policies; measuring manufacturing carbon emissions; optimising logistics to reduce carbon emissions; implementing environmentally-friendly packaging; aiming to reduce, reuse, and recycle when using resources; and creating carbon emissions awareness among consumers (Sundarakani, De Souza, Goh, Wagner and Manikandan 2010). The designed framework will use some of the above-mentioned actions as options to investigate the effect on the supply chain and the environment, and to quantify the benefit.

To develop the analytical framework, other frameworks identified though research will be investigated. The frameworks were selected after an initial screening to see whether the frameworks addressed environmental processes, best practices, and financial impact. The frameworks in question are the Voluntary Environmental Standards, GreenSCOR, Toyota 5R Principle, Environmental Engineering Group Environmental Costing Model (EEGECOST), LCA, and Du Pont Analysis.

2.2.2.1 Voluntary Environmental Standards

The Electric Utility Industry Sustainable Supply Chain Alliance (EUISSCA) (n.d.) states that they released a set of voluntary standards that take the environment into account. Industry partners and government institutions assisted in developing the standards, which aim to create awareness among utility suppliers about their actions, and about the impact they have on the environment. They also note that the standards offer companies a list of initiatives that can be implemented to improve their environmental performance.

The voluntary standards from the Sustainable Supply Chain framework can assist a company on the journey from compliance to leadership. Figure 5 shows the framework.

The first step in implementing the framework is to comply with regulations and environmental laws and to seek constantly to improve *compliance*. The next step is to initiate *continuous improvement* to benchmark against best practices, identify room for improvement, and perform gap analysis to ensure adherence to certifications. Actions also included in the continuous improvement phase are the reduction of environmental impact and the effort to create a paperless environment for invoicing, payment, and contracts (EUISSCA n.d.).

EUISSCA (n.d.) states that the *integration* step in the framework involves the Global Reporting Initiative (GRI), which is the sustainable reporting of environmental factors on company websites and in annual and sustainability reports, to ensure that the framework aligns with the corporate strategy, and to design processes that integrate sustainable environmental practices into business practices. EUISSCA (n.d.) also mentions that the *innovation* step follows integration, which is the continuous improvement of operations and processes. The last step is *leadership* – that is, publically sharing what has been learnt with stakeholders and company employees.

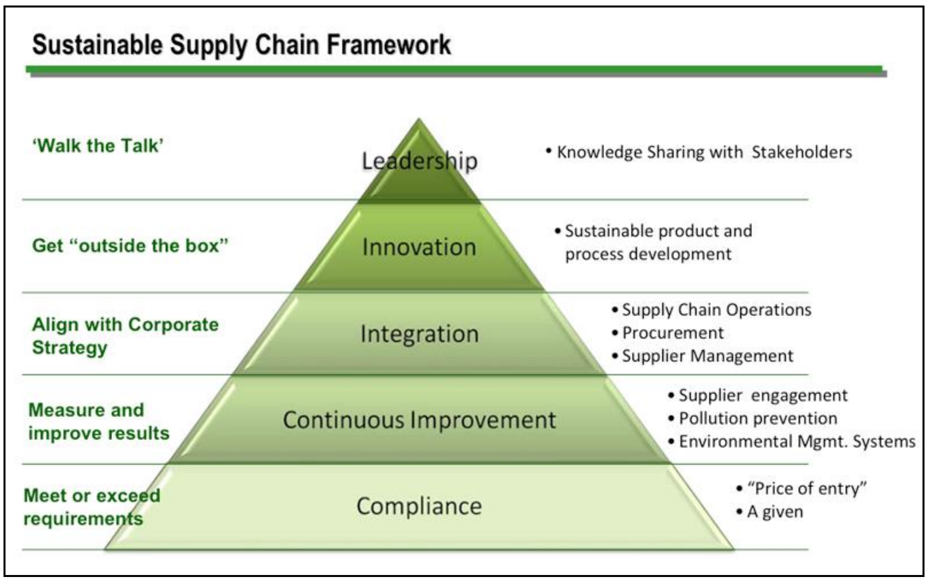


Figure 5: The EUISSCA's Sustainable Supply Chain Framework (Adapted from EUISSCA 2010)

EUISSCA (n.d.) continue that a wide range of supply chain activities is covered by the framework. This includes procurement practices, innovation initiatives, and reporting of current data. They add that the areas addressed by the framework are environmental compliance and policies; energy usage and conservation; emissions (for example, air; GHG, and transport); water usage and pollution; management of hazardous and non-hazardous materials; waste reduction; chemical reduction; and biodiversity.

The framework includes the views of and the legislation affecting the organisations that are mainly based in the United States of America (USA) and Europe – for example, ISO 140001 and the Carbon Disclosure Project (CDP). ISO 140001 addresses supply chain analysis, the auditing of current operations, and performance evaluation. The CDP is a database in which organisations record their GHG emissions and green environmental strategies. The framework also assists companies with financial and policy decision-making (EUISSCA n.d.).

A shortcoming of this model in quantifying GSCM is that the cost of going green is not considered: the model is focused more on compliance. However, the EUISSCA's Sustainable Supply Chain framework will be used as a guideline to develop the framework, and will aid in understanding the process of moving from compliance to leadership.

2.2.2.2 GreenSCOR

Stewart (1997) explains that the SCOR model is a framework to measure supply chain performance across different industries. According to the SCC (n.d.), the SCOR model is a combined structure linking metrics, processes, industry best practices, and people. Implementing the SCOR model can improve supply chain management by enhancing communication between departments and partners in the supply chain. The SCOR model assists in the evaluation of supply chain activities against performance measures, and is used globally. It evaluates the whole supply chain, and is a supply chain management tool. It also assists organisations in increasing current inventory turns; it increases system implementation; and it supports learning programmes by providing the basic building blocks, flows, and best practices of processes that are required to support the activities.

The SCC (n.d.) comments that the SCOR model assists with effective supply chain management by recording business activities for end-to-end supply chain activities, mapping the supply chain in simple process blocks, and aiding in the understanding of the whole supply chain in a wide range of industries. It adds that the SCOR model can be adapted to a specific project or to a global project. It can also identify a single process that must be improved, and by how much. Also included in the SCOR model are customer measurement scorecards and standard company processes.

The SCC (n.d.) indicates that the model ranges from the suppliers of the supplier to the customers of the customer. Figure 6 gives an overview of the SCOR model, linking the company to suppliers and customers. The figure also illustrates the building blocks – *plan*, *source, make, deliver, return*, and *enable* – of the SCOR model, which is organised around the primary management 'level one' processes (building blocks of a supply chain). *Plan* involves all the processes involved in planning the supply chain for sourcing the raw materials (*source*), manufacturing (*make*), warehousing and distribution (*deliver*), and managing the reverse leg of the supply chain (*return*). *Enable* is the management of the inventory, data, capital assets, technology, etc.

The five primary management 'level one' processes can be broken down into a more detailed second level. The *plan* function will include planning the *make*, *source*, and *deliver* functions. The third level will be the *source*, *make* and *deliver* functions, which divide into *make to stock*, *make to order*, and *engineer to order* products. *Make to stock* will be used where products are manufactured to store before selling, and are based on a forecast of what the business will sell in a given period. *Make to order* business will operate on orders, and will react once the order is placed. *Engineering to order* products are those where the design must be finalised and that need to be assembled once the orders have been received from the customer (SCC n.d.).

Enable functions will be the technology and processes enabling the functions (SCC n.d.). Figure 7 illustrates the three different process levels. The reference model can be used to describe any supply chain, no matter how complex. The different level processes for *plan, source, make, deliver*, and *return* functions are summarised in Van Zyl (2010) and presented in Appendix A.

The SCOR methodology contains metrics, processes, practices, and people. A supply chain can be assessed on its agility, responsiveness, reliability, supply chain costs, and the amount of assets. There are three different levels of metrics. The first level measures the overall position of the company; the second level focuses on the root cause of the first level; and the third level focuses on the detail of the second level. By moving down the levels, more detail will be included. For example, level one will be the *'order fulfilment cycle time'*; the second level will be the cycle time in more detail – the *'source cycle time', 'make cycle time'* and *'deliver cycle time'.* The *deliver cycle time* can be broken down into level 3: '*build loads cycle time'* and *'consolidate orders cycle time'* (SCC n.d.).

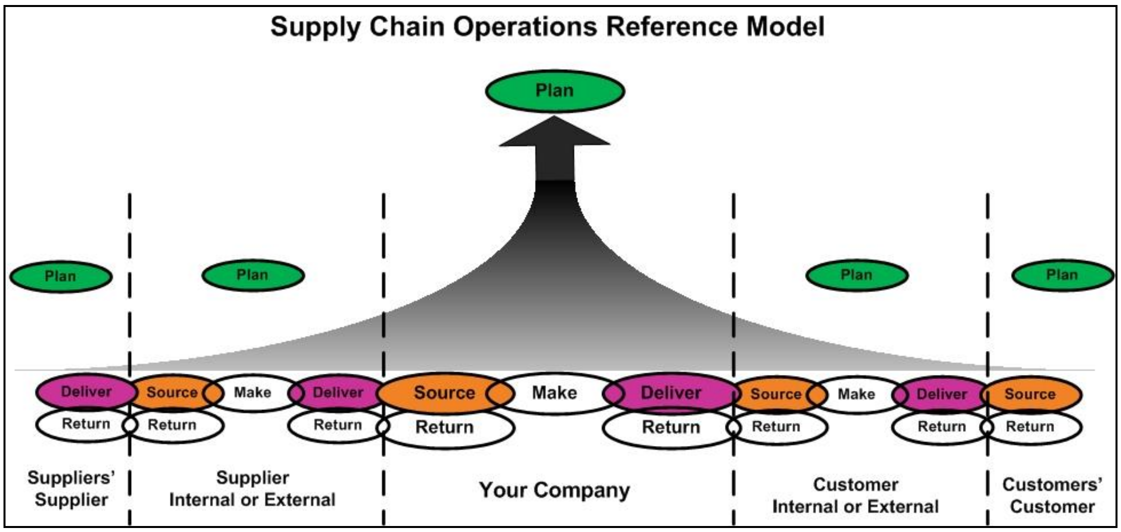


Figure 6: Supply Chain Operations Reference Model (Adapted from SCC n.d.)

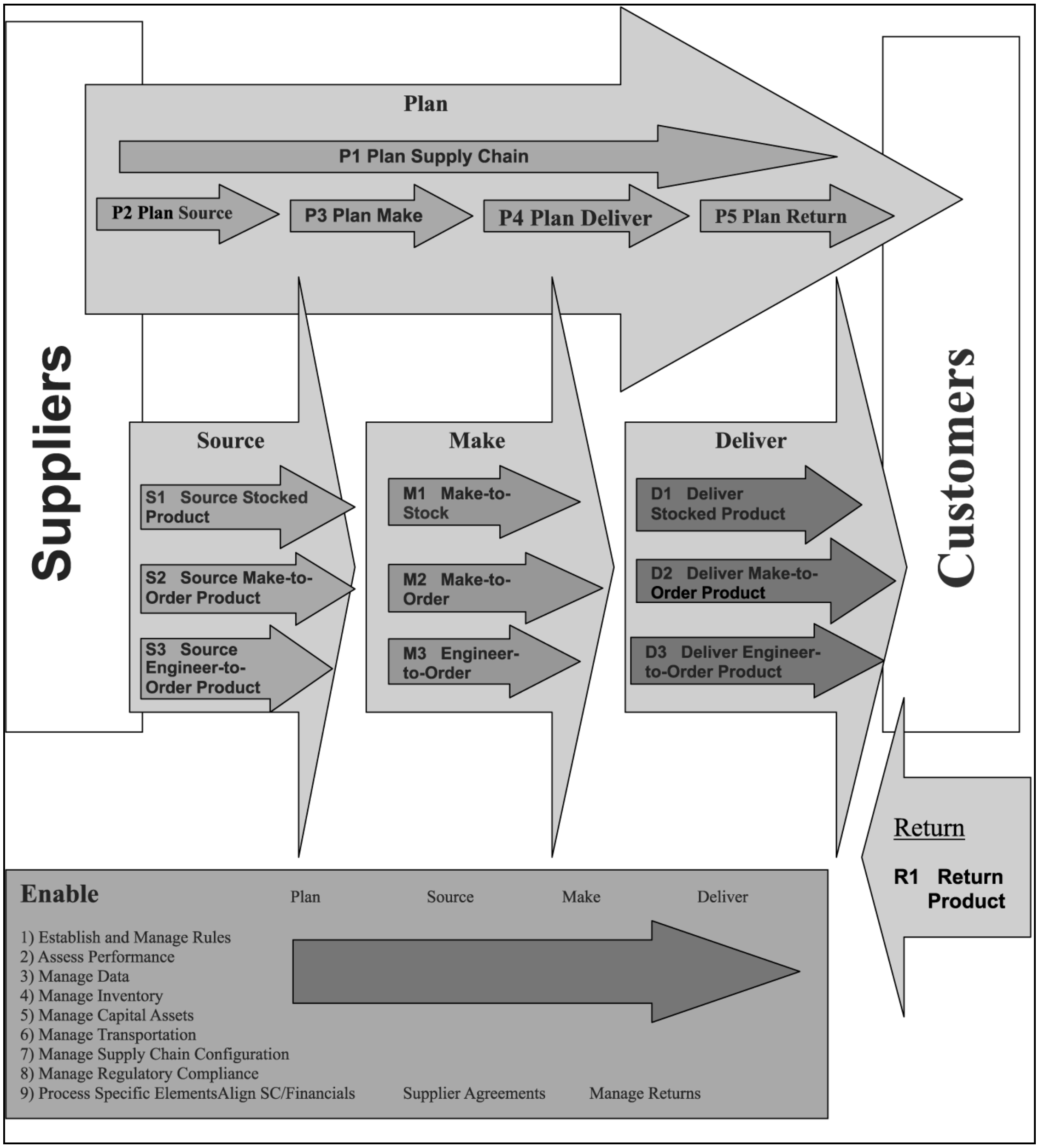


Figure 7: Overview of *plan, source, make, deliver*, and *return* process (Adapted from SCC n.d.)

The SCC (n.d.) notes that SCOR has both advantages and disadvantages that need to be considered, and that must be known before implementing the model. The SCOR model excludes any research, development of technology and products, or marketing functions. It adds that quality functions, business administration, and any information technology functions are not included in the model. Van Zyl (2010) concludes that the warehouse functions are incorporated in SCOR, but with a limited focus on the processes and sub-processes of the warehouse operation.

An addition to the SCOR model, GreenSCOR includes environmental management elements in the SCOR 9.0 model, with the latest being SCOR 11.0. GreenSCOR can be used to assess the total environmental impact and to act as a reputable GSCM tool for comparable results.

SCOR is a proven Supply Chain Management framework, and therefore GreenSCOR would be an ideal tool for GSCM (SCC n.d.). According to Wilkerson (2009), environmental processes, measures, and best practices are included in the SCOR model. The environmental metrics would be used to measure the total environmental footprint of an end-to-end supply chain. Also, the best practices of processes and metrics could be available for comparison purposes, and to establish the current company performance and what environmental initiatives could be considered to increase environmental performance. GreenSCOR is an add-on to the original SCOR model, and maintains its integrity. The GreenSCOR metrics are *carbon emissions, air emissions, liquid waste, solid waste,* and *recycled waste*. Carbon emissions are used as a measure to quantify GHG emissions in tonnes of carbon dioxide (CO_2). Air emissions are emissions from major pollutants, and liquid waste is the weight of waste that flows into water or sewerage systems, both measured in tonnes or kilograms (kg). Solid waste is the weight of waste generated by a specific process, also measured in tonnes or kilograms. Recycled waste is the percentage of solid waste that can be recycled through the process, reported as a percentage. The five metrics are measured for each level 3 process, and then added together to obtain the values of the level 1 and 2 processes (SCC n.d.).

The GreenSCOR metrics can all be converted into carbon emissions to calculate the total supply chain footprint, as illustrated in Figure 8. Recycled waste is subtracted from the total waste generated when the total carbon footprint is calculated. The level 2 processes – *plan, make, source, deliver,* and *return* – all contribute to the total supply chain carbon emissions (level 1 process). The GreenSCOR metrics are used to convert all environmental impacts in the case studies to carbon emissions. The environmental impacts are assessed in total carbon emissions.

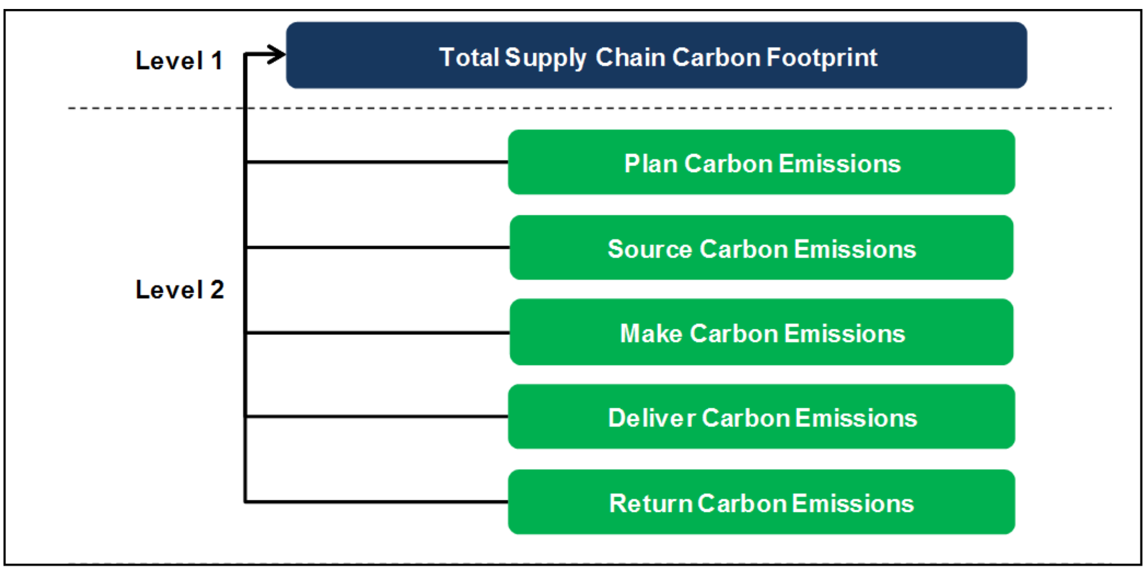


Figure 8: Total Supply Chain Footprint (Adapted from SCC n.d. and Van Zyl 2010)

For the conversions, DEFRA's (n.d.) carbon emissions conversions are used. DEFRA is a government department in the United Kingdom that is responsible for environmental protection, food production and standards, agriculture, fisheries, and rural communities in Great Britain and Northern Ireland. According to DEFRA (n.d.), GHGs consist of seven main gases that contribute to climate change. As defined by the Kyoto Protocol, these are CO_2, methane (CH4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). To adhere to the Kyoto Protocol, all gases generated in all activities must be reported. DEFRA (n.d.) also states that CO_2e is the universally-accepted measurement to indicate the global warming potential (GWP) of GHGs, which is reported as the GWP in units of CO_2.

For each activity there are predefined factors that can be used to calculate the carbon emissions. The Department of Environmental, Food, and Rural Affairs (DEFRA) (n.d.) explains that, to calculate the carbon emissions, the data per activity must be converted into carbon emissions using a predefined carbon emissions table with standard conversions. (See Appendix D for illustrations of the emission table from DEFRA.) If emissions factors are not available from DEFRA, they can be obtained using emission factors developed by environmental agencies, monitoring programmes, regulatory reports, waste shipping documents, and environmental permits (SCC n.d.).

Figure 9 illustrates the best practices of the planning process in the GreenSCOR model that are linked to the level 3 and 2 processes, and from there link into the level 1 process, which is the total supply chain carbon footprint. For example, one of the best practices of the level 3 *plan make (carbon emissions)* is to *minimise energy usage*, which can be achieved by using alternative machinery or re-engineering the process to result in lower carbon emission impact. This best practice links to the process '*P3.4 Establish production plans'*, which links to *process 'P3 Plan make carbon emissions'.* From there it flows into the level 2 process *'Plan carbon emissions'* and ends in the level 1 process *'Total supply chain carbon footprint'.* A similar approach can be followed to determine the process of the other best practices of *source, make, deliver*, and *return* processes. The remainder of the processes can be viewed in Appendix A. Using this model as reference makes it possible to link the best practices, processes, and metrics when using the GreenSCOR model in the case study, and also to use it as a source of information when developing the framework.

GreenSCOR can be used to assess the total environmental impact and act as a repeatable GSCM tool for comparable results. Schoeman and Sanchez (2009) mention some of the GreenSCOR metrics that can be implemented at each phase of the supply chain. In the *planning* process, supply chain partners need to investigate collaborative planning processes and plan how to minimise the usage of energy. *Sourcing* involves sourcing from vendors that have an environmental management system. They add that the *make* function focuses on the minimal usage of resources, whereas the *delivery* function focuses on optimising distribution and minimalising fuel usage. The *return* function includes all product returns that make financial sense.

Cash and Wilkerson (2003) discuss the advantages of using GreenSCOR. These are: the ability to link carbon emissions to a specific process; to help to improve efficiency in the supply chain; to help to translate strategic carbon emission plans by linking them to specific activities; and to understand the root cause when targets are not met. The GreenSCOR methodology will be the base from which the framework will be developed, in order to ensure that the whole supply chain is covered from the *plan, source, make, deliver*, and *return* process perspective. The GreenSCOR model's best practices will also be used to link the emissions plan to specific activities. The GreenSCOR model will also be applied in the FMCG business in a case study so that the model can be compared with the developed framework.

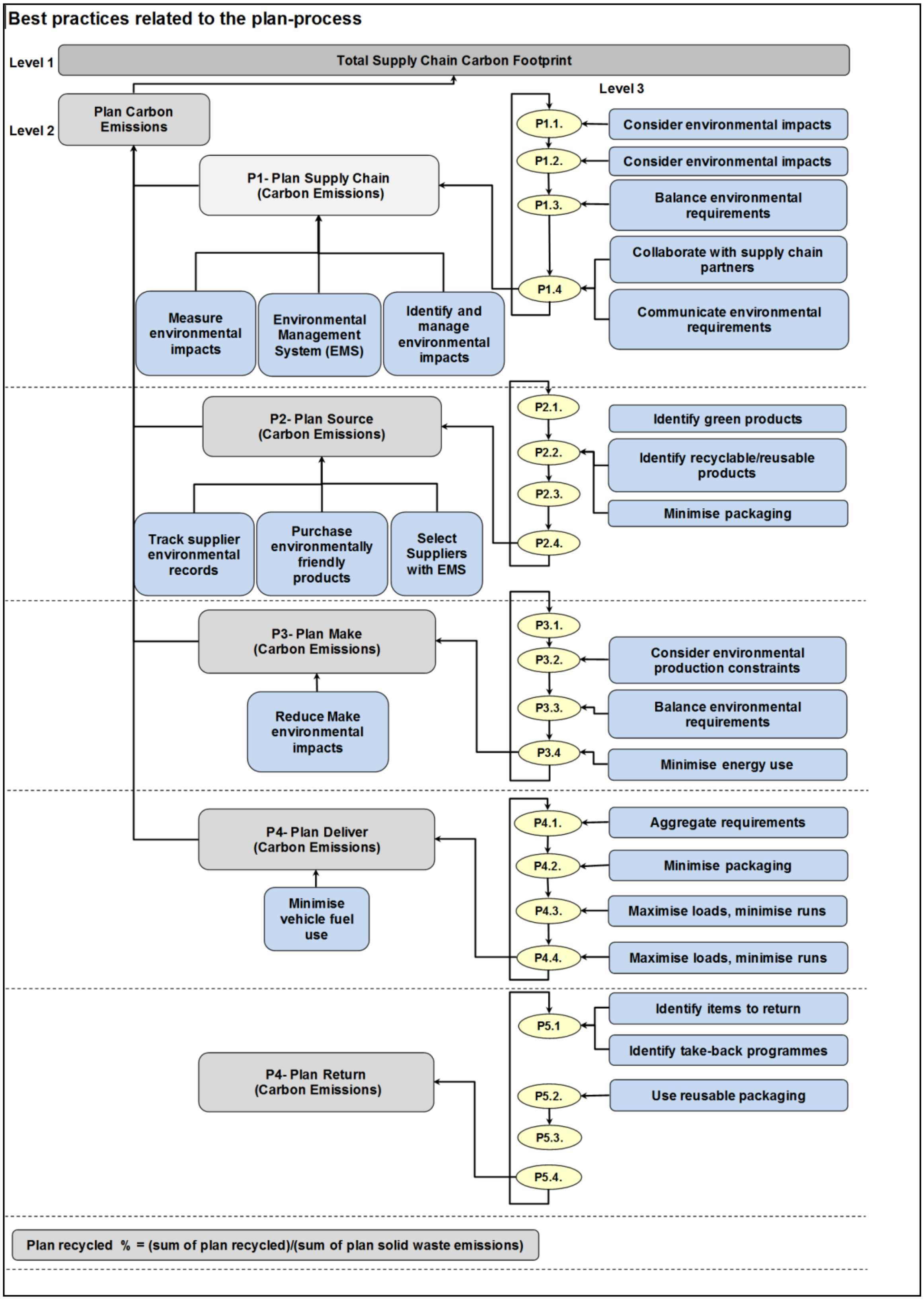


Figure 9: Best practices related to the planning process using GreenSCOR (Adapted from SCC n.d. and Van Zyl 2010)

2.2.2.3 Toyota 5R Waste Management Principle

Black and Phillips (2010) state that the goal of green manufacturing is to limit waste at the end of the supply chain. The Toyota Production System (TPS) focuses on reducing any form of waste in the manufacturing environment that flows over to the rest of the supply chain. Toyota also developed the 5R program to help reduce pollution at its source on the manufacturing line. Black and Phillips (2010) also explain that green manufacturing in a factory focuses on reducing emissions, wastes, material usage, energy usage, and waste generated by distribution and support functions. Table 3 summarises the Toyota 5R approach, where waste is categorised as *refine, reduce, reuse, recycle*, and *retrieve* energy.

The *refine* measure includes changing the conversion factor of the product or process so that fewer resources will be consumed in manufacturing. *Reduce* covers the waste output that must be reduced. *Reuse* focuses on reusing resources – for example, recycling cooling water in a manufacturing plant. *Recycling* can cover processes in production and other departments to recycle waste. *Retrieve* investigates energy retrieval from waste material when the other measures are not successful (Black and Phillips 2010).

Table 3: Toyota 5R approach (Adapted from Black and Phillips 2010)

Category	Measure			Responsibility
Waste to source control	Conversion	Refine	Expansion of reduce, reuse and recycle by changing design and raw materials	Production technology and other departments
	Reduction of amount of waste	Reduce	Reduction of amount of waste generated at source	
		Reuse	Reuse within production processes	
After treatment measures	Recycling	Recycle	In-plant reuse of generated waste	
			Outside reuse of generated waste	
		Retrieve Energy	Recovery of energy from waste materials that cannot be refined, reduced, reused and recycled.	Environmental technology departments

A shortcoming of the Toyota 5R approach is that it focuses mainly on the manufacturing environment and not on the supply chain as a whole. The research question to quantify the impact of environmental initiatives on business profitability and sustainability across the entire supply chain will not be addressed using this framework; but waste from the production department could be managed by using it. The concepts of refine, reduce, reuse, recycle and retrieve energy can be used to identify other green options in the rest of the supply chain, and will be used in the framework to identify green measures that must be quantified, and to group initiatives.

2.2.2.4 Life Cycle Assessment (LCA)

Clift and Wright (2000) summarise LCA as an approach in which the whole supply chain must be included. The assessment begins at the start of the supply chain by identifying resource usage, waste, and emissions generated. Williams (2009) indicates that the LCA considers all the major stages in the life cycle of a product. The stages are: procurement of raw material, handling and distribution of raw material, production, handling and distribution of finished product, product life, and waste management.

'Product life' refers to the emissions that the product has during normal operation, and 'waste management' refers to the end of the product's life cycle.

The LCA method consists of four major steps that need to be performed in sequence. Figure 10 summarises this method. The first step is the *definition and scope*, which is to determine what information is required, how to acquire the information, and how to evaluate it. The second step is the *life cycle inventory (LCI)* process, which includes data collection with the help of process maps and evaluation of the data. The *life cycle impact assessment (LCIA)* is the next step: it focuses on the part of the process that is affected, what costs are associated with it, and grouping of the costs. The final step is data evaluation and report writing (Williams 2009).

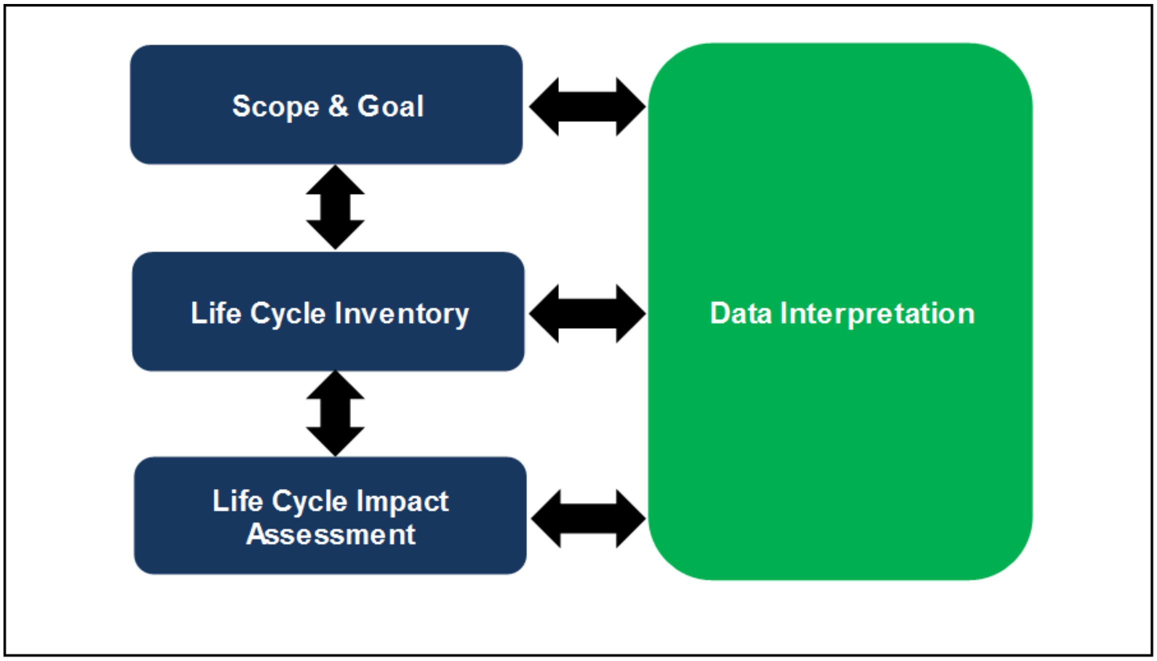


Figure 10: LCA method's process steps (Adapted from Williams 2009)

Williams (2009) endorses the LCA method by describing its benefits: the calculation of the total environmental impact of a product, being able to identify all environmental aspects (positive or negative), the identification of process and product improvements, the justification for a product or process change, and the use of available data to compare different processes.

The LCA measures the impact on the environment for the different processes in the product life cycle. But this method is not suitable if the aim is to quantify the impact of green supply chain principles on business profitability. The LCA only measures the environmental impact by quantifying resource usage, waste, and emission per area of the supply chain, not the impact on business profitability – a factor that is required in order to answer the research question (De Bruijn, van Duin and Huijbregts 2004).

The LCA model's output will be used as the developed framework's input, by incorporating all the building blocks in a systematic process overview, using the modular approach of calculating carbon emissions, and by looking at the detailed process view (De Beer and Friend 2006).

2.2.2.5 Environmental Engineering Group Environmental Costing Model (EEGECOST)

Chowdhury and Hamid (2013) state that environmental accounting can be used to convert social and environmental liabilities into environmental costs. They add that the EEGECOST framework was developed to explain and quantify environmental accounting principles in South Africa. De Beer and Friend (2006) add that accounting and budgeting are the two main functions of the model. The accounting function includes allocating environmental costs to specific cost types (cost centres), while capital budgeting is used to plan the next financial year by creating cost centre budgets and monitoring spend.

Soltanali, Hagani and Yaftabadi (2008) explain that the principles of the total cost assessment (TCA) environmental accounting system form the basis of the EEGECOST model. They add that the EEGECOST model has five steps. The first is to scope the project and understand the objective statement, background of the company, and the manufactured products. The second step is the LCA, followed by the cost inventory step, which includes dividing costs into different sections. The fourth step is the environmental impact assessment and the fifth step finalising the results.

De Beer and Friend (2006) indicate that the model breaks the environmental costs down into different cost types: recurring site costs, non-recurring site costs, corporate costs, impact costs, internal intangible costs, and external costs of the full product life cycle. They explain that recurring site costs are those associated with everyday production costs, while non-recurring site costs are once-off production costs or an investment in the production processes.

Corporate costs are the overhead costs of the business. Impact costs are those associated with the production area. Internal costs are the day-to-day operational costs, and external costs are those outside the business, for which the business is not responsible. The model will give the cost-per-function per cost type (De Beer and Friend 2006).

De Beer and Friend (2006) explain that the model uses the LCA method output as an input to the model in order to translate environmental costs, and to allocate the specific cost types and drivers to an economic value. Soltanali *et al.* (2008) indicate that the economic value will take present and future costs and revenues into account and categorise them into different environmental media groups: *air, climate, wastewater, soil and ground water, noise and vibration, biodiversity and landscape radiation*, and *other costs*.

De Beer and Friend (2006) report that the model works well when quantifying the environmental costs per functional unit. The environmental costs are compared on an annual basis to understand the impact on direct and indirect production environmental initiatives.

The model's concept of breaking costs down into functional units and allocating economic value will be used in the framework. The EEGECOST only focuses on production and on activities related to the production of a functional unit; it does not model the impact on profit and on the rest of the supply chain. This will be the aim of the developed framework.

2.2.2.6 Du Pont Analysis

The Du Pont analysis acts as a compass by pointing out strengths and weaknesses in financial statements. The method measures Return on Equity (ROE), and is a good starting point for financial analysis. ROE measures the rate at which the company's wealth is increasing (Isberg 2012).

Kumar *et al.* (2011) mention that ROE is a good metric to measure business profitability. But ROE on its own does not provide enough detailed insight into the cause of profitability growth. Kumar *et al.* (2011) therefore ascertain that DuPont analyses that break down the ROE into several factors will be more beneficial to use.

Isberg (2012) explains that the Du Pont model consists of three parts: profitability, operating efficiency, and leverage. Profitability measures the rate at which sales are converted into profit at different organisational levels. Operating efficiency measures the rate of cash generation using the assets of the business. Leverage measures the dependency of the company, using debt financing. Isberg (2012) concludes that the Du Pont analysis consists of general high-level measures that are calculated from income statements and balance sheets. However, he emphasises that using the Du Pont analysis is not a replacement for a detailed lower-level investigation.

Kumar *et al.* (2011) contribute two case studies, from Apple Inc. and Coca Cola (Pty) Ltd. In the case study of Apple Inc., the ROE is broken down into Operating Efficiency, Asset Use Efficiency, Financial Leverage, ROE, and ROE without financial leverage. The measures were recorded for five years, and the conclusions were that Apple's asset utilisation declined over the years; that the company focused on driving profitability through operational activities and not by focusing on asset utilisation; and that Apple might show a lack of focus on greening initiatives in the supply chain.

In the Coca Cola (Pty) Ltd case study, the analysis of financial data over five years shows a significant change in asset utilisation and financial leverage. The company started implementing green supply chain measures; and Kumar *et al.* (2011) state that the primary benefit of implementing a green supply chain was improved asset utilisation..

These case studies used secondary data. It is suggested that future research use historical company data to measure true profitability changes. Historical data will be used in the framework developed, because such data offers a more accurate picture of the company's operations for the previous financial year, and takes a longer period into account (Kumar *et al.* 2011).

These case studies by Kumar *et al.* (2011) show that there is a need to measure the impact of green supply chain initiatives on profitability, and that the DuPont analysis can be a method to use. However, it does not provide lower-level data, and does not indicate which part of the supply chain contributed to the increase in profitability. In order to answer the research question on a total company level, the Du Pont method can be used – but it will only indicate the utilisation of resources, which will not necessarily mean that environmentally-friendly initiatives have been implemented. It could just mean that the business is more productive. Therefore the DuPont method is not an accurate method to use in answering the research question.

2.2.3 Decision-making methods in GSCM

2.2.3.1. Relationship between environmental impact and supply chain performance

Walker, Di Sisto and McBain (2008) conclude that suppliers are not drivers of environmentally-friendly initiatives. Many drivers and barriers exist when dealing with GSCM. Walker *et al.* (2008) add that there are positive attitudes towards environmentally-friendly initiatives, with more drivers than barriers identified.

Barriers can be an internal or external influence on an organisation. Internal drivers are organisational drivers, and include the desire to reduce costs, pressure from investors, and improved quality. External drivers are regulations, customers, competition, and society. Competition drivers include a company's financial performance, and gaining a competitive advantage in the market place. The cost of manufacturing a product together with the selling price, drives some of these initiatives; and it is emphasised that the cost of implementing environmentally-friendly initiatives must not add to the cost of the product and supply chain (Walker *et al.* 2008).

Clift and Wright (2000) state that when analysing certain products, the environmental and financial benefits are in conflict with each other – that is, implementing green initiatives might not be the best option to reduce costs, and vice versa. Clift and Wright (2000) also highlight that there is a need to monitor the environmental cost at the different steps in the supply chain to make sure that it makes financial sense.

Clift and Wright (2000) add that the ideal balance between cost and environmental initiatives is where there is a positive environmental impact and no extra cost is added to the supply chain. A high economic value will result in sustainable development, while a low economic impact with high environmental impact will result in unsustainable activities. The global average is where both the environmental impact and the economic impact are at acceptable levels. They conclude that a company will still need to monitor costs, even if green supply chain initiatives are good for the environment. The company cannot implement these initiatives if profit margins are eroded as a result.

Azevedo, Carvalho and Cruz Machado (2011) explore the relationship between supply chain performance and green supply chain initiatives. The automotive industry was used as a case study to evaluate the influence of environmental initiatives on the performance of the supply chain. A theoretical framework was developed (shown in Figure 11), and it indicates that environmental management principles influence supply chain key performance indicators (KPIs). Azevedo *et al.* (2011) report that environmental collaboration with customers had a positive influence on the quality of the product and on customer satisfaction. Minimising waste in this case had a negative impact on cost and business wastage, implying that one process was optimised in the supply chain at the expense of another. Another example is implementing reverse logistics, which can have a positive impact on efficiency but will increase cost.

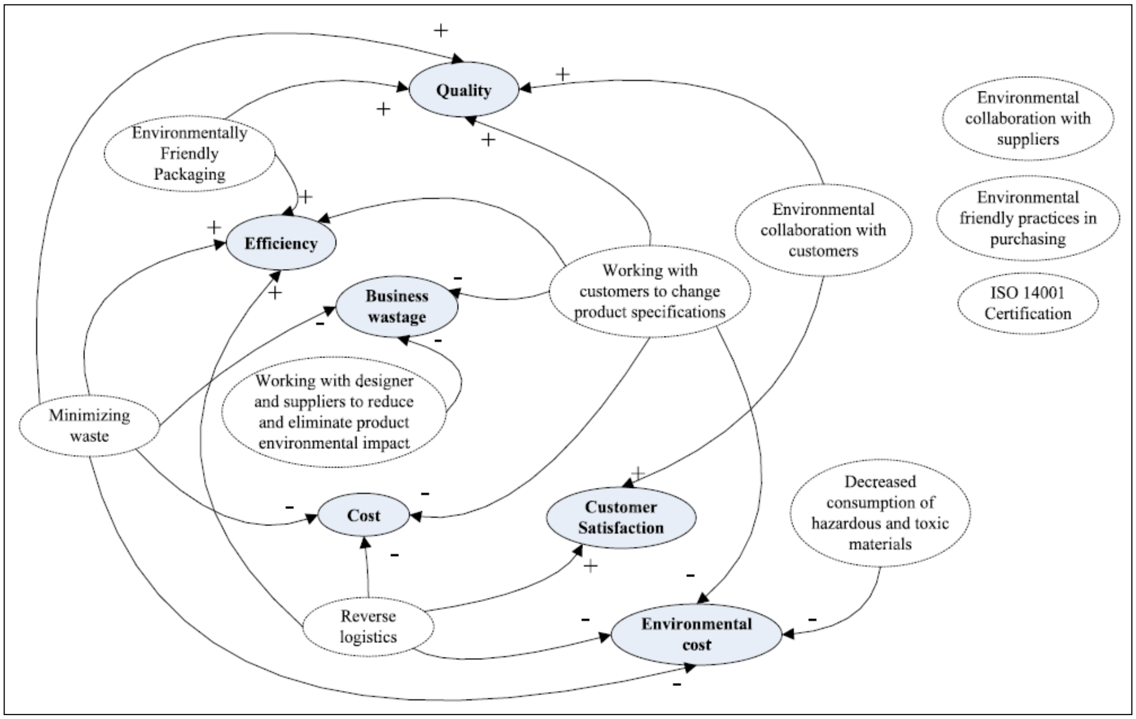


Figure 11: Influence of green practices on supply chain performance (Adapted from Azevedo *et al.* 2011)

Azevedo *et al.* (2011) rank the environmental optimisation initiatives from different case studies in their research. Reverse logistics are ranked as one of the more important supply chain initiatives, alongside minimising waste and ISO 14001. Working together with customers to change product specifications and environmental packaging are also popular initiatives. The analytical framework needs to be able to quantify the different initiatives in terms of cost and impact on profitability.

In considering the relationship between green supply chain initiatives and supply chain performance, the developed framework will focus on quantifying the impact of these initiatives on the cost base.

2.2.3.2. Performance Measures

Beamon (1999) comments that traditional supply chains include the following building blocks: supply, manufacturing, distribution, retail, and the customer. In traditional supply chains, customer service and cost are important performance measures to drive efficiency and effectiveness in the supply chain. Beamon (1999) argues that, for comprehensive supply chain management, it is important to design, implement, and analyse performance measures, because they are used to compare current system performance against competing alternatives.

Beamon (1999) says that the extended supply chain includes similar building blocks to those of the traditional supply chain – but they also include return supply chain information and flows. Beamon (1999) identifies a need to develop performance measures that include economic efficiency and environmental protection. He also identifies performance measures that will aid in managing a supply chain from an environmental point of view. An adapted performance management system is necessary to help organisations to achieve competitive advantage when implementing sustainable supply chain processes. Mutingi, Mapfaira and Monageng (2014) support this statement, adding that the motivation to adopt green supply chain practices differs between organisations. The adoption of green practices is mainly the result of external pressure; and the company will adopt green supply chain practices at a high level to meet the minimum requirements. Mutingi *et al*. (2014) add that the main reason that companies are wary about incorporating green initiatives into their business is the challenge to justify the economic benefit. The lack of performance measurements contributes to the challenge to quantify the tangible benefits associated with implementing green supply chain initiatives.

Environmentally-friendly performance measures consider all forms of waste, energy usage, and resource consumption. Identified environmental performance measures include resource consumption (energy and material), total life cycle cost, eco-efficiency (using minimum resources to add maximum value), and life cycle cost reductions associated with improvements (Beamon 1999). More recently, Azfar, Khan and Gabriel (2014) have pointed out that performance measures can be divided into environmental performance (EP), economic performance (ECP), and operational performance (OP). The environmental performance category includes the measurement of air, emissions, waste water, and solid waste reductions. Cost reduction of materials, energy, waste treatment, waste discharge, and environmental accidents fall under the ECP category; and all of these form part of the total life cycle cost. The aim is to use minimal resources for maximum value. OP includes a decrease in inventory levels, a decrease in scrap rate, improved capacity utilisation, and on-time deliveries.

Van Hoek (1999) argues that there are more measurements to use in green supply chains, and that carbon emissions are just one of them. His suggestion is to consider the supply chain as a whole – to consider all initiatives, and not just focus on single initiatives such as logistics and regulatory compliance. Van Hoek (1999) also mentions that optimising one initiative can be to the detriment of another. Significant research is also required to apply green initiatives to the whole supply chain.

Beamon (1999) concludes that it is important to consider the whole life cycle effect of a product on the environment, and that supply chain analyses must include performance measures associated with the total life cycle impact to produce sustainable supply chains. Olugu, Wong and Shaharoun (2011) conclude that the main key performance indicators of green supply chain initiatives can be summarised under the term ‘greening cost’ – that is, all the costs incurred when running an environmentally-sustainable business. These include the costs of environmental compliance, energy, environmentally-friendly material, and revenue. Environmental compliance costs are those incurred by the company in adhering to environmental regulations; energy costs are those consumed by the manufacturing function to produce the product; environmentally-friendly material costs refer to the costs of investing in environmentally-compliant raw materials; and revenue costs are the capital costs for implementing green supply chain initiatives.

Mutingi *et al.* (2014) have identified the following green performance metrics categories: environmental, economic, and social responsibility performance. Environmental performance metrics are air emissions, water pollution, solid waste, and energy consumption. ECP metrics are reverse logistics costs, sustainability costs, and energy consumption costs. Reverse logistics costs are the costs associated with returning the product and some materials, while sustainability costs are those associated with implementing sustainable processes. Energy consumption costs are the costs of electricity and other sources of energy used. Social responsibility performance metrics include the company's green image, the perspective of customers, scrap rate, and recycling activities. 'Green company imaging' refers to how the company markets itself by referring to existing green supply chain activities, and how it is seen from the perspective of the customer. Scrap rate is measured as the percentage scrap vs total products manufactured. Efficiency of recycling activities can be measured using the reduction of raw material used in manufacturing a product.

Murby and Gloud (2005) point to the balanced scorecard as a management framework that has been adapted over the years from Kaplan and Norton's original framework of the early 1990s. Kaplan (2010) remarks that the balanced scorecard aims to drive long-term shareholder value by using four types of metrics: *financial, learning and growth, customer*, *and internal process* metrics. Murby and Gloud (2005) explain that the *financial* perspective includes concepts such as asset utilisation, improved costing models, and increased customer value. From the customer's perspective, this will include excellence in operation, customer involvement, and product leadership in the market place. *Learning and growth* includes the corporate culture, the competency of employees, and technology. *Internal processes* include logistics, customer management, and environmental processes.

Hervani, Helms and Sarkis (2005) illustrate how green performance metrics can be grouped using the balanced scorecard framework. Financial metrics include direct expenditures for the company, while internal processes include the recycling of manufacturing processes and direct office materials. Customer perspective metrics focus on product eco-efficiency and the learning and development gained from environmental training and response programmes.

Tsai *et al.* (2010) group environmental costs into activity centres and activity drivers linked to the centres. The activity centres are pollution prevention activity, resource recycling activity, administration activity, research and development activity, and social activity. The pollution prevention activity is the prevention of water and air pollution, measured in kilogram carbon emissions ($kgCO_2e$) and cubic meter (m^3) water pollution. Resource recycling activity is measured by the ability to recycle and dispose of general and hazardous industrial waste (measured in tonnes). Administration activity is the monitoring of environmental impact through various audits and the numbers of hours spent training employees. The research and development activities are measured as the numbers of hours spent on reducing environmental impact in the manufacturing and distribution stages. Social activity is the number of meters of greenery planted as part of nature conservation, and the amount of money spent on supporting environmental activities.

Performance measures monitor the performance of the supply chain; and so the developed framework needs to measure the impact on profitability and sustainability when green supply chain performance measures increase or decrease. The return leg impact on the supply chain also needs to be incorporated into the developed framework. Both economic and environmental performance measures will be included in the framework. The full end-to-end supply chain will be included to determine which performance measures to include. The balanced scorecard approach will be used as a guideline to group economic and environmental improvement initiatives into categories in order to make it more manageable. The following categories will be considered as a guideline: *financial, customer, internal process*, and *learning and development* (Beamon 1999; Hervani *et al.* 2005; Kaplan 2010; Tsai, Lin and Chou 2010; Mutingi *et al.* 2014).

The activity centres identified by Tsai *et al.* (2010) can be incorporated into the balanced scorecard approach. They fall mainly in the financial, internal processes, and learning and development categories.

2.2.3.3. Analytical Models

Sarkis (2002) identifies an analytical model (ANP) as a network process that is used to assist managers in evaluating the impact of green supply chain initiatives such as technology investments, partnerships, and origination practices. The outcome of the study showed that the ANP methodology can assess the major strategic decisions faced by businesses in GSCM. He concludes that the application of the model is limited due to its complex characteristics, and that it must be tested in more industries. He also feels that the model is not easy to understand and apply, and cannot be applied in everyday decision-making.

Wang, Lai and Shi (2011) suggest that network analysis be used to analyse the impact of supply chain design on green supply chain initiatives. The model considers the impact of the handling and transportation processes. Different network design options were investigated, and the finding of the study was that the bigger the network, the more opportunities there are to optimise. Optimisation opportunities include finding the optimal route and minimising the carbon emissions output in the network. The optimisation of the network includes reducing the number of kilometers travelled by consolidating loads, and combining routes. The reduction in kilometers will have a direct impact on the amount of carbon emission generated, as fewer kilometers are travelled and less fuel is used.

Wang *et al.* (2011) conclude from their case studies that the supply range – the number of distribution centers (DCs) from which the product can be distributed – will have an impact on the total cost and on carbon emissions. The change in network needs to be justified by the total cost and carbon savings. Future research opportunities include demand fluctuations, raw material sourcing, and changing transportation modes in the analysis to determine the impact on operation and supply chain cost.

Lee and Cheong (2011) state that the organisation needs to prepare to take a position against climate change, and that this might require the organisation to adopt a system or framework that measures carbon emissions, and a way to measure efficiency across the whole supply chain. In their research, they developed a framework to measure the carbon in the manufacturing process. The framework measures the carbon emissions (in kilograms) of raw materials, manufacturing, and distribution processes, enabling the company to understand their total manufacturing carbon footprint.

Seuring and Muller (2008) research sustainable supply chain management by comparing 191 different papers from 1994 to 2007. From their research, two types of supply chain management strategies are discussed. The first strategy is *supplier management*, which involves the risk and performance of suppliers, and requires suppliers to have environmental and social standards in place as minimum requirements, thus enabling the company to avoid some of the environmental and social risks.

The second strategy summarises *supply chain management for sustainable products*, taking the whole product life cycle into account. There must be constant communication between the business and their suppliers. The aim must be to produce sustainable products if the strategy is to succeed (Seuring & Muller 2008).

Various ANPs already exist. But for the development of the proposed framework, some of these frameworks are not suitable. From others, however, some key learnings and methods can be accommodated in developing the framework. The ANP of Sarkis (2002) will not be included due to its complex characteristics. The findings of Wang *et al.* (2011), which suggest that network analysis be used to analyse the impact of green supply chain initiatives, will be incorporated into the model to plan the network strategically, with cost and environmental impact minimisation in mind. Principles from the carbon emission framework developed by Lee and Cheong (2011) will be also incorporated into the model as one of the measurements of environmental impact. The supply chain management strategy developed by Seuring and Muller (2008) will be used as a reference point when developing the framework, to ensure that it addresses the full life cycle of the supply chain.

2.2.3.4. Green Supply Chain Management (GSCM) Life Cycle Approach

Schoeman and Sanchez (2009) state that to manage GSCM effectively, a total end-to-end supply chain focus is required. Various inputs – product design, delivery, and disposal of the product – must also be considered in evaluating the total supply chain. They support the concept of minimising raw materials, financial input, and waste, while profits and production must be maximised. The reason for this is to spend the minimum amount of money to produce the product, creating the lowest cost price of the product and resulting in increasing profitability for the products. Implementing environmental initiatives can result in cost-saving and increased profitability. Schoeman and Sanchez (2009) explain that 'green gold' is the term that will apply when the maximum returns are earned from implementing cost-saving green supply chain initiatives.

In the case study of Schoeman and Sanchez (2009), the extra kilometers travelled due to supply chain inefficiencies were calculated, as were the extra kilometers linked to carbon emissions. This was linked to the average cost per kilometers (based on vehicle specifications) and the fuel consumption per kilometer. The above-mentioned data was used to plot the week's extra kilometers versus actual kilometers required to travel. Extra kilometers travelled are caused by two main factors: unplanned deliveries, and DCs that cannot supply the product, requiring the truck to be redirected to another distribution centre.

Schoeman and Sanchez (2009) report that the value of the extra kilometers travelled is R6.5 million, and that this is equal to 941 additional tonnes of carbon, resulting in added pollution. The model must still be tested in other industries; and it only considers transportation costs as a driver of green supply chain cost.

Toke, Gupta and Dandekar (2010) summarise the environmental and operational functions involved in a supply chain. Figure 12 illustrates the energy and waste output of each function of the supply chain. The four major functions in a supply chain include inbound functions, production, distribution, and outbound functions. The inbound function involves the selection and certification of a vendor, while production includes all the functions that relate to the physical process of producing the product. Distribution (outbound functions) involves storage and the delivery of the product to customers.

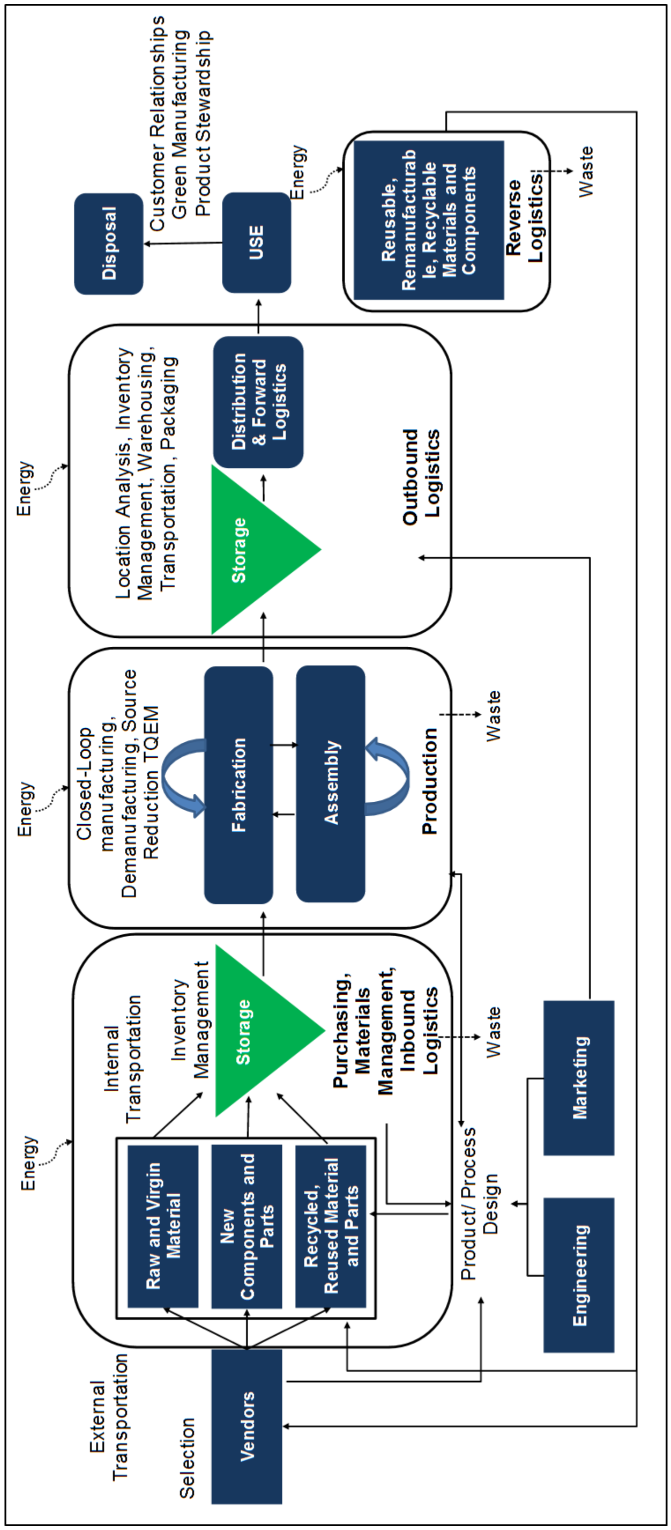


Figure 12: Environmental practices in the supply chain (Adapted from Toke *et al.* 2010)

Toke *et al.* (2010) explain that, to optimise the environmental impact of inbound logistics, the just-in-time (JIT) principle can be used to ensure just enough raw materials, thus optimising storage space and using less raw material storage. They add that using JIT will minimise storage cost of inbound materials because no extra space will be required and optimising current facilities will reduce warehousing cost per product and in return reduce the cost price of the product.

Toke *et al.* (2010) agree that distribution can be optimised by considering lower cost transportation modes or minimising return loads, thus directly influencing the amount of carbon emission generated by the transport of the product from source to destination. Reverse logistics are part of the cost of the disposal of a product. In most cases, the customer will be responsible for the costs – for example, with computers or cameras.

Toke *et al*. (2010) conclude that the trade-offs for environmental impact and cost are the flexibility, speed, and timing of the supply chain. Supply chain flexibility means the flexibility of having different transportation modes and production capacity that is available to use in peak times, which might result in a greater environmental impact through the increase in resources in the supply chain. These resources might not be used fully, and so can increase costs. To increase the speed of the supply chain, faster and larger resources will be required for production and distribution, resulting in increased environmental impact and cost. Automation can also be considered, resulting in a higher supply chain cost but producing at greater speed.

From the study of Toke *et al.* (2010) it is clear environmental impact and cost must be analysed in conjunction with each other, and that there is a trade-off between these factors. Their analyses highlight the operational and environmental functions in the supply chain. This will be used in the developing phases of the framework to ensure that all the aspects of the supply chain will be included in the framework, and to ensure that the framework will focus on quantifying the trade-off between the environmental and cost impact of operations in the supply chain.

Rao and Holt (2005) report on a constructed model that aims to illustrate the relationship between supply chain ECP, competitiveness, and supply chain management. Their first realisation was that GSCM assessment must consider the entire supply chain, not just single sections of it. Another finding was that GSCM leads to cost savings, and so to better ECP and increased competitiveness in the supply chain. The study also found that optimising the inbound and production functions in environmental initiatives will lead to a significant increase in greener outbound operations. Optimisation will also lead to an increase in the competiveness and profit of a company.

Rao and Holt (2005) find that optimising the inbound functions of GSCM involves the integration of suppliers into the green supply chain. This involves enforcing rules that require suppliers to have an EMS, greening their operations and eliminating waste at source. Gains will include minimised environmental waste, reduced pollution, improved use of resources, and improved ECP. Greening the production activities will result in the reuse of materials, an increase in recycling initiatives, and less pollution. This will lead to cost savings in raw materials, lower water and electricity consumption, and an overall increase in profitability and competitiveness in the market place.

The framework design will focus on quantifying the impact of GSCM activities that are involved in the life-cycle of manufacturing the product but not on quantifying the impact of supplier actions. From the study of Rao and Holt (2005), this will include the impact of greening production activities, and in return will quantify the cost-saving in terms of profitability.

Dües, Tan and Lim (2013) find that both lean and green supply chain initiatives take into account the attributes of waste, techniques of waste reduction, reduction of lead times, service level, and supply chain relationships. Combining the two paradigms will result in an optimised supply chain from a lean and cost perspective. They add that the lean methodology does not include carbon emission reporting, life cycle analysis, or end-of–life-cycle analysis. The lean methodology's main KPI is cost and green supply chain initiatives focused on carbon emission reduction. In the development of the framework, the reasoning of Dües *et al.* (2013) will be applied to combine lean and green initiatives in order to reduce carbon emissions and cost, and to determine the impact of each.

Lee (2011) finds that is it important to measure the direct and indirect sources of carbon emissions across the supply chain. Figure 13 illustrates the scope of carbon emissions in the supply chain. Carbon emissions are created indirectly by suppliers, and then directly by production activities and distribution, and from there the product will be moved to the customer for consumption. The research study also states that sustainable production – which involves green procurement, recycling, and recovery activities – will lead to sustainable distribution and consumption; while sustainable consumption includes sustainable distribution practices, recycling, and recovery.

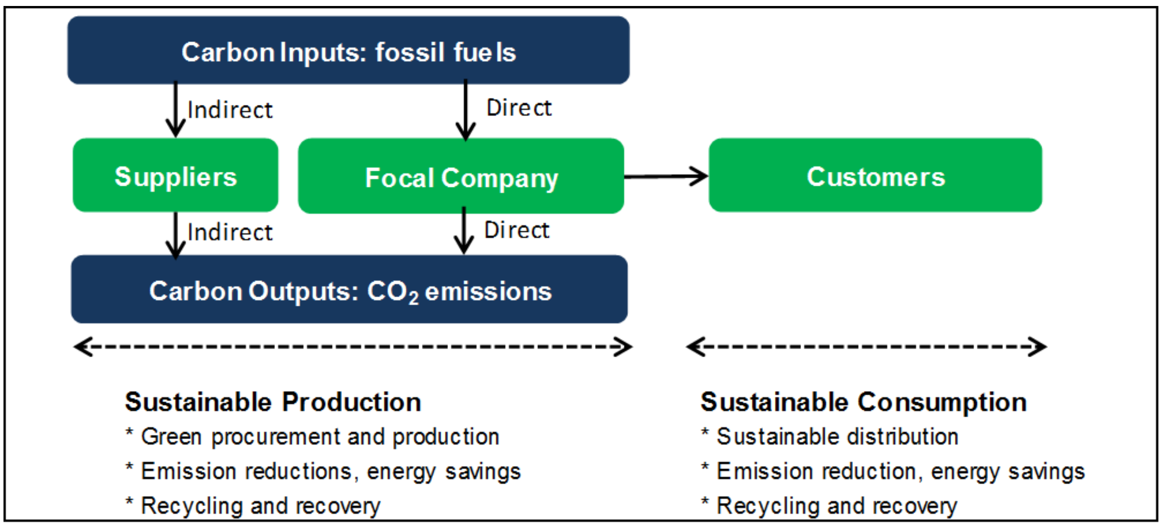


Figure 13: Direct vs. indirect effects of carbon footprint in the supply chain (Adapted from Lee 2011)

Lee (2011) concludes that it is strategically important to manage environmental initiatives across the whole supply chain, and not just in a single process. This will have the biggest impact on reducing carbon emissions. To assess emissions accurately, both indirect and direct emissions must be included in the analyses.

Ubeda, Arcelus and Faulin (2011) perform a case study to investigate the potential reductions in emissions resulting from green practices in logistics management. They conclude that minimising distances will result in cost savings and create efficiency. Costs can also be reduced by implementing backhauls to reduce running empty return legs.

In developing the framework, the conclusion of the study by Lee (2011) will be incorporated into it by analysing initiatives across the supply chain instead of only focusing on a single process. Ubeda *et al.* (2011) focus their case study on environmental impact reduction in logistics processes; and this will be used to investigate the possible impact on profitability when implementing some of the initiatives, such as optimising return loads.

Chaabane *et al.* (2012) conclude that a carbon emission trading scheme will force companies to look again at supply chain activities to make them more environmentally-friendly. The use of life cycle analysis will maximise sustainability in the long-term. The research findings of Chaabane *et al.* (2012) again stress the importance of a full life-cycle analysis; and this concept will be one of the fundamental principles on which the developed framework will be built. Also, with carbon emission trading as a possibility, green initiatives will require more attention in future. Here, the framework could assist a company to analyse the effect on profitability when implementing green supply chain initiatives.

2.2.3.5 Cost Modelling

Timme (2005) states that few companies realise the potential of using SCM as a tool to drive financial performance. Strategic and tactical supply chain decisions cannot be made without considering the whole supply chain. An end-to-end supply chain overview is required to understand the full impact of supply chain initiatives.

Decisions involving transportation, procurement, and replenishment are often made while considering only one section of the supply chain. Improving one initiative can result in increased costs in other forms – for example, higher inventory costs and warehouse expenses. This again highlights the fact that optimal supply chain management will not be achieved if a total supply chain view is not considered (Timme 2005).

Timme (2005) recommends the use of a three-step framework to link supply chain management and environmental performance. The process will begin by benchmarking financial metrics and understanding the gaps. This is followed by mapping the financial gaps between supply chain management and business strategies. Finally, solutions to improve supply chain management processes will be explored to yield optimal financial returns.

Timme (2005) also comments that gaps in measuring supply chain financial performance result from analysing processes in isolation, and for accurate analyses, the supply chain must be considered as a whole to determine the true financial impact.

Jooste and Van Niekerk (2009) note that the distribution costs of companies in the South African market account for 5 per cent to 15 per cent of their total sales value. In tough economic times, companies all seek and implement cost-savings measures and look for ways to increase profit.

Freeman, Haasz, Lizzola and Seiersen (2000) report that, when it comes to customer profitability, 50 per cent of the customers are responsible for 95 per cent of company revenue. The focus needs to be on initiatives aimed at the customers who will have the largest impact on profit. Companies spend a great deal of time introducing new products into the market to grow their current market share, but little time is spent understanding true customer profitability per channel, major customer groups, regions, brands, pack sizes, delivery routes, and customers.

The argument of Freeman *et al.* (2000) that profitability is driven by 50 per cent of the customers will be investigated with the developed framework, to ensure that the focus is on the correct customers and green initiatives in order to contribute positively to productivity. As noted by Jooste and Van Niekerk (2009), the distribution cost forms a large portion of the total 'cost to serve' for the product. So various cost saving initiatives – for example, minimising travelling distances and using different types of trucks – will be tested in the developed framework to test the sensitivity of profitability and sustainability measures. The impact of implementing green initiatives on the supply chain as a whole, and not on isolated part of it, will be assessed by incorporating the end-to-end supply chain view into the developed framework (Timme 2005).

2.2.3.5.1 Product Costing

Norek and Pohlen (2001) address the issue of supply chain optimisation in their research, and state that not knowing the true cost to service a customer causes difficulty in designing the optimal supply chain. The ideal analysis will be to include both cost and profit per customer.

Product costing includes all the direct and indirect (overhead) costs associated with procuring raw materials (receiving, storage, sales, picking, dispatch, and overhead costs) and all the costs associated with manufacturing the product. Manufacturing cost includes all the direct (labour, electricity, water, etc.) and indirect (overheads) production costs associated with converting the raw material into a finished product. Figure 14 explains the product flow through the supply chain and the costs included in the product cost calculations (circled in red) (Jooste and Van Niekerk 2009).

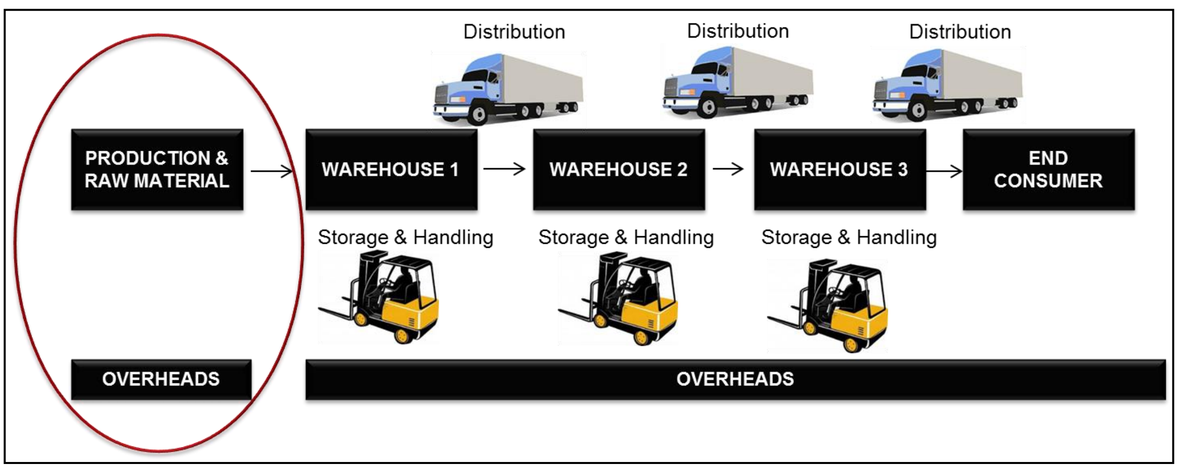


Figure 14: Product costing (Adapted from Jooste and Van Niekerk 2009)

Jooste and Van Niekerk (2009) explain that product-costing calculations are based on ABC models. ABC works on the principle that all the activities that are involved in producing the product need to be identified, and that the cost of all the activities must be included in the total cost. The ABC analysis focuses on all the value- and non-value-adding activities of converting the raw material into the finished product. The processes involve all the activities involved in sourcing the raw material, the raw material purchase cost, and manufacturing the product.

The ABC method will assign more indirect costs to the direct costs associated with a product. Indirect costs – i.e., management and overhead costs – are supporting activities that are not directly related to a specific product, and must be related back to a unit cost. By assigning costs in this way, it is possible to calculate the cost of producing a single product or delivering a service. An investigation into these costs can then lead to identifying high cost contributors and reducing or eliminating unnecessary costs. Overpriced and less profitable products can also be identified. This will enable companies to use the analysis in strategic decision-making and productivity initiatives by focusing on the products that are responsible for the most profit, and by changing the process and costs that will have the biggest effect on profitability (Jooste and Van Niekerk 2009).

The ABC method is a management accounting tool that efficiently identifies the actual costs associated with an activity (Capusneanu 2008). It can measure the savings as a result of reusing and recycling products by measuring activity contribution cost. Activity contribution cost is the cost per unit that the activity contributes to the total ‘cost to serve’ of the product. Reusing and recycling will reduce the consumption of material, resulting in a lower overall product cost.

Lessner (1991) indicates that product costing can be used in any type of firm and that, as long as a product or service is produced or sold, there will be a cost associated. The issue in multi-product manufacturing facilities is that all manufacturing costs are evenly distributed among all manufactured products; and this will skew the manufacturing price by not showing the real price for products that are expensive to manufacture. The profitability of products is very important to a company in order to ensure that the right strategy per product is implemented, to minimise cost. The ABC analysis will enable companies to understand the true profitability of their products.

The ABC methodology will be used to calculate the product costing, and will be applied in the framework by assuring that all raw material and manufacturing costs are assigned to a specific product (Jooste and Van Niekerk 2009). In the company chosen for the case study, the products will be broken down into brands, and all the costs will be assigned to what raw materials each brand uses, on which production line the product was made, and what overheads need to be assigned to the brand. This will give a unit cost of Rand-per-case and Rand-per-kilogram (kg) value per activity for raw materials and production. The framework is not limited to manufacturing firms: it could be adapted for non-manufacturing firms. Hilton (1991) adds that the calculation of costs in a non-manufacturing firm is simply the total cost to merchandise a product or supply a service. Service-orientated companies do not offer products that can be stored or transported, but costs related to offering the service need to be tracked. Examples of these industries include insurance companies, restaurants, airlines, and banks.

2.2.3.5.2 The ‘cost to serve’

Dawson Consulting (n.d.) states that cost visibility per customer is critical. Many costs are involved in transporting the completed product to the customer – for example, sales and marketing costs, warehousing costs, transport costs, and overhead costs. All of the costs have their own drivers. Before a product is completed, raw material costs, raw material storage cost, and manufacturing costs also need to be considered. The cost structure and cost links per product are illustrated in Figure 15. The product type will influence sales and marketing costs, while the product type configuration will influence warehouse cost. The channel and customer type drives transportation cost. The administration costs are driven by the customer type – for example, wholesalers vs retailers.

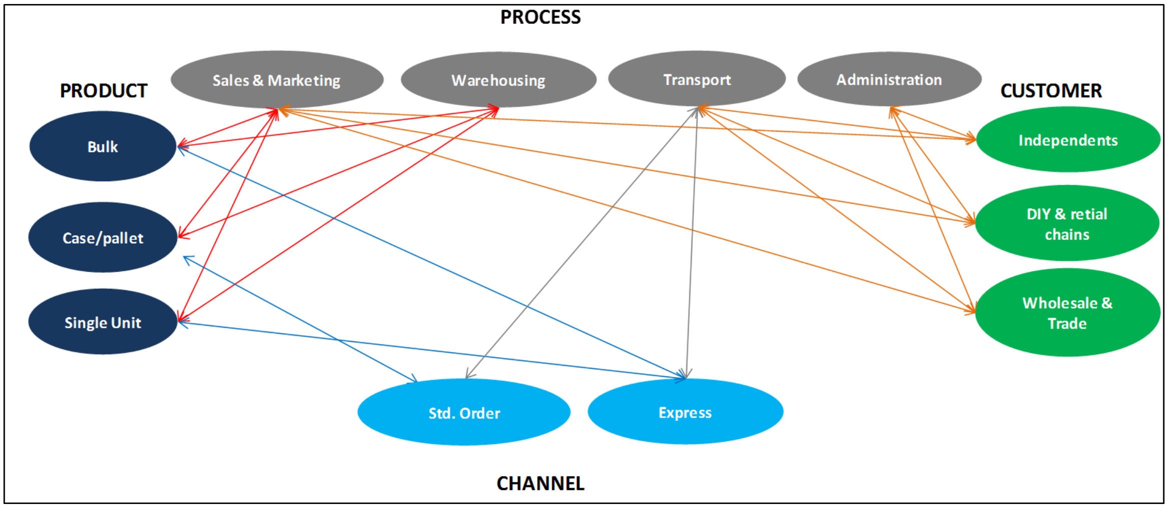


Figure 15: 'Cost to serve' (Adapted from Dawson Consulting n.d.)

'Cost to serve' is the cost involved in the distribution of the product from the source (after leaving the point of manufacture) to the end customer. Costs include warehouse costs, distribution costs, management costs, and overheads. Figure 16 below explains the costs involved (circled in red). Distribution costs, distances, and volumes are taken into account when performing the calculations (Dawson Consulting n.d.).

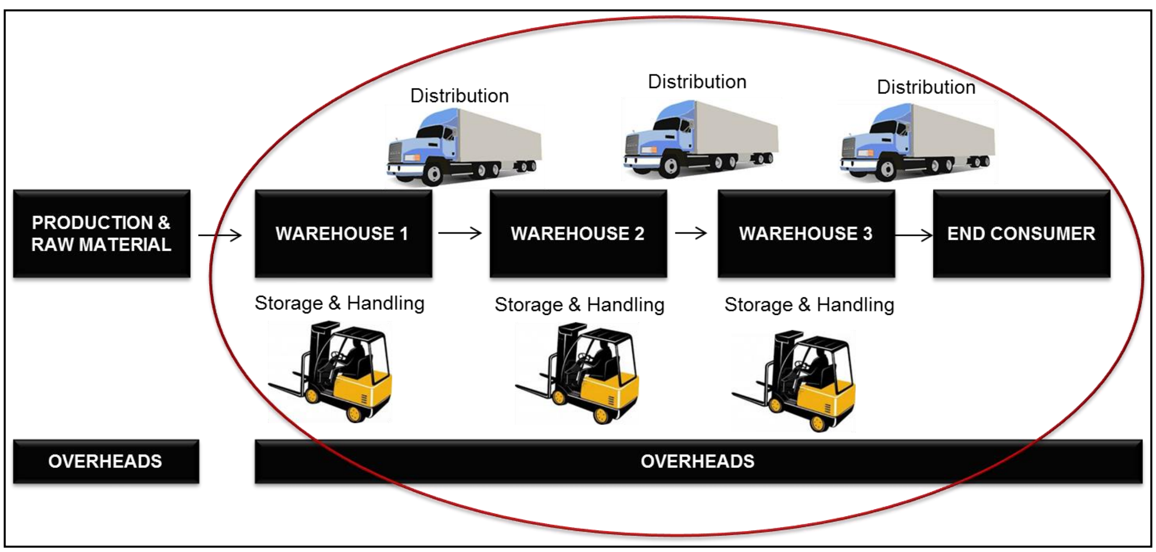


Figure 16: 'Cost to serve' methodology (Adapted from Jooste and Van Niekerk 2009)

As mentioned earlier, the product costing calculations are based on the ABC modelling methodology (Jooste and Van Niekerk 2009). The 'cost to serve', which is the part of the supply chain after product costing, is also based on the ABC modelling methodology, and involves all activities and costs associated with storing, distributing, marketing, selling, and general overhead costs of the product. The level of detail, and decisions about which costs to include, can be determined by each analysis.

It will be beneficial to use ABC in the developed framework to determine the 'cost to serve', because all costs are calculated by tracing the product flow back from the customer to the warehouse facility. This methodology will make customer-specific and detailed analysis possible. The cost drivers are also identified, and their impact understood in the supply chain. Another benefit is that the costs can be aligned to different routes and customers, to increase profitability per route and ensure that a customer group can receive customised service packages. The ABC methodology will also provide a systematic approach to understanding customer profitability and what the main drivers are. This information will help companies not to react to short-term solutions, but rather to focus on sustainable long-term solutions (Jooste and Van Niekerk 2009).

2.2.3.5.3 Business Profitability Modelling (BPM)

Ernst and Young (n.d.) comment that the 'cost to serve' methodology measures the behaviour of an organisation by breaking up the costs into different types and understanding the contribution of each. The gross sales value (GSV) is the amount for which the product is sold to customers. The next step is to break down all the cost contributors that need to be deducted from the gross GSV to obtain the net sales value. Then all the 'cost to serve' elements are deducted to calculate the pocket price (PP). From the PP the cost of goods sold (COGS) is deducted to obtain the marginal customer profitability (MCP). The remainder of the overhead costs are deducted to arrive at the true profitability, namely the pocket margin (PM). Breaking the costs into the different contributions makes it easy to understand where extra costs are added in the supply chain, and what effect those have on the profit. BPM is a combination of product costing and 'cost to serve' modelling to get the full end-to-end supply chain impact. Business profitability calculates the profit contribution at the level of customer, product, route, etc. All costs in the financials of a company must be included in the analysis, to arrive at the true cost of a product (Ernst and Young n.d).

Jooste and Van Niekerk (2009) show the different levels in an organisation's financial statements where costs are recorded (see Figure 17). The gross value is the value paid by the customer for the product. The sales discounts are deducted from the gross value to obtain the net sales value. Then the indirect and direct production costs are deducted from the net sales value to arrive at a gross contribution per customer and product (product cost). Marketing, sales, logistics, and overheads will form part of the 'cost to serve' costs and, once they have been deducted from the product costing, they will be the customer contribution to overheads and profit.

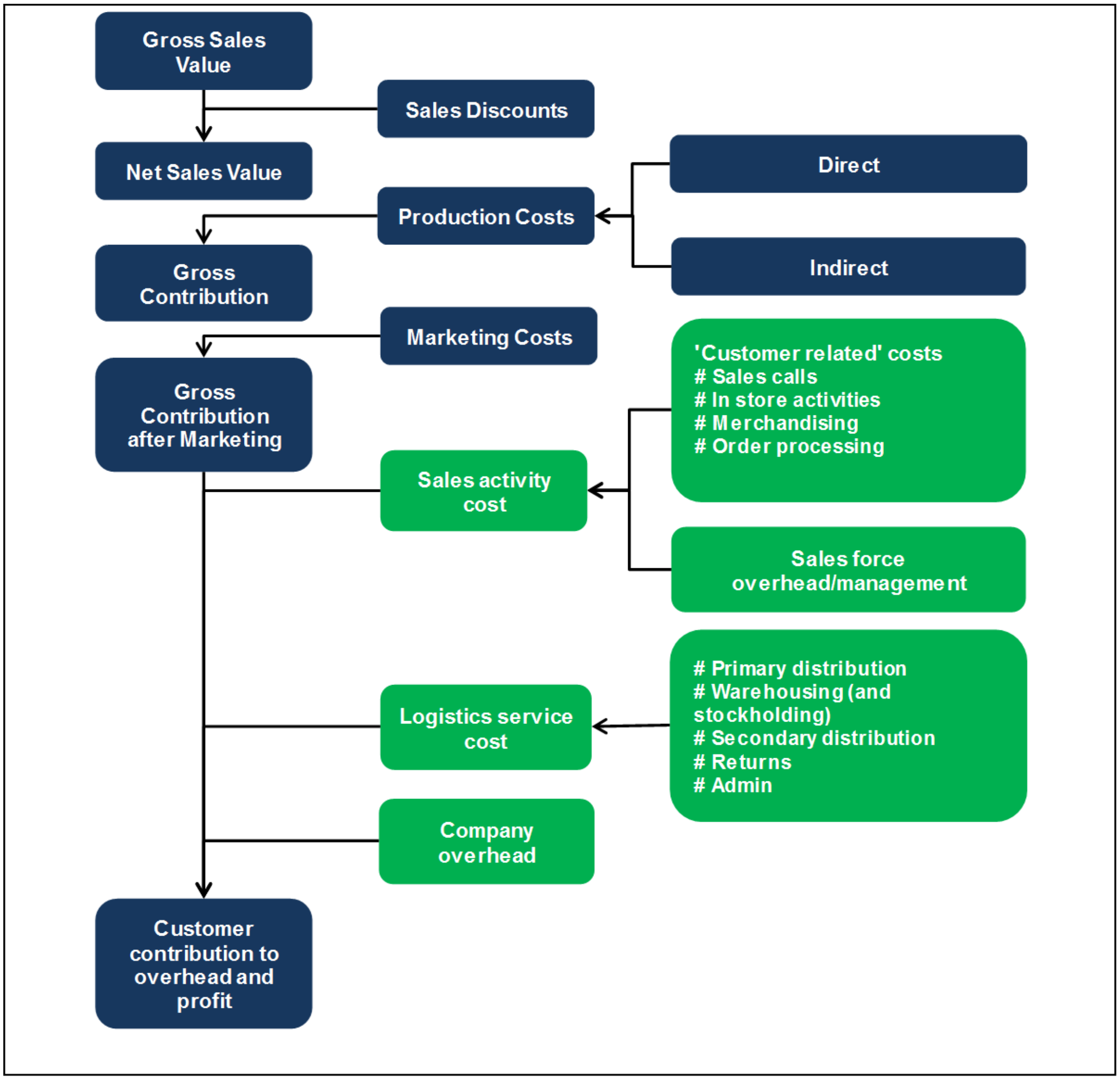


Figure 17: Cost allocation (Adapted from Jooste and Van Niekerk 2009)

Tsai *et al.* (2010) use ABC costing to determine the contribution of the environmental cost to the total product costing in a company case study approach. However, the contribution of the environmental cost is not related back to the impact on the profitability of the company on a product and customer level. The framework presented in this document also uses ABC costing, and addresses this gap to determine the impact on profitability on an overall company level and on the lowest customer level. Capusneanu (2008) recommends a method that can be used to implement green supply chain initiatives together with the ABC method. This method assign costs to processes, activities, and products, and adds the environmental impact to these costs in order to analyse the combination of environmental and product costing. There is a need to take the impact of ABC costing further and to relate it to profitability. The developed framework will address this need to analyse the impact of green supply chain initiatives on profitability.

The above examples from Jooste and Van Niekerk (2009) and Ernst and Young (n.d.) demonstrate that the full end-to-end supply chain cost can be assessed by applying the ABC method to analyse supply chain costs. The impact of environmental cost on product costing can also be analysed using the ABC method (Tsai *et al.* 2010; Capusneanu 2008). BPM is the next step to quantify the impact of green supply chain initiatives on business profitability on both an overall company level and a detailed customer level (Ernst and Young n.d.).

2.2.4 Previous Research in an End-to-end Supply Chain Matrix View

In an effort to understand current green supply management concepts and frameworks that have been developed in the existing literature and as discussed above, various journals have been used as a major source of research. The literature study highlighted some of the major contributions to GSCM to be the combination of ABC costing with environmental costing, the development of green supply chain performance measures and decision-making methods, and the development of GSCM frameworks and best practices in GSCM. These journal articles were combined into a matrix (see Appendix C) to summarise green supply chain research according to the applied research methodology, the core focus areas in the supply chain, and the industry in which the research was conducted. The reason for creating the matrix was to understand the current green supply chain research focus areas and their supply chain application, and to determine gaps for future research.

The main outcomes of selected articles are included in the green supply chain matrix, some of which were discussed earlier in the literature review. In total 40 articles are included in the matrix from a range of journals, including *International Journal of Production Economics, Journal of Environmental Science & Policy, Journal of Environmental Economics and Management, Journal of Resources, Conservation and Recycling, Journal of Transportation Research, Journal of Technological Forecasting and Social Change, Journal of Cleaner Production, Journal of Purchasing & Supply Management, The IUP Journal of Operations Management, Journal of Decision Support Systems, International Journal of Operations and Production Management, Journal of Cleaner Production, International Journal of Production Economics, Journal of Industrial Management and Data Systems, Journal of Remanufacturing, Benchmarking: An International Journal, Journal of Logistics Information Management, Journal of Production Research, International Journal of Production Economics, International Journal of Production Research, International Journal of Retail and Distribution, International Journal of Operations and Production Management, Journal of Resources, Conservation and Recycling, International Journal of Management Reviews, International Journal of Environmental Science and Technology, Journal of Supply Chain Management,* and *Journal of Social and Behavioural Sciences*. Other sources considered include a Council for Scientific and Industrial Research (CSIR) and Cardiff University case study presented at the 28th annual Southern Transport Conference in South Africa in 2009, Proceedings of the 2010 International Conference on Industrial Engineering and Operations Management in Bangladesh in 2010, a study done by the Norwegian University of Science and Technology in 2002, and a publication of Greenleaf Publishing in 2001. The matrix summarises the research methodology into theory application, case study application, survey or interview, ANP, numerical experiment, and review of previous methodologies or models.

The core research focus in the matrix refers to the areas in the supply chain to which the research applies. The areas are *plan, source, make, deliver, return, enable*, KPI metrics, and previous research. The areas used to group the research activities in the supply chain are from the SCOR model discussed earlier (SCC n.d.). The industry focus in the matrix refers to the industry represented in the research from among the following categories: FMCG, manufacturing other (manufacturing excluding FMCG), agricultural, petroleum, electrical, technological, and other.

The research suggests that, if companies greened their supply chains, not only would they achieve substantial cost savings, but they would also enhance their sales and market share, and exploit new market opportunities, leading to greater profit margins – all of which contributes to the ECP of the firm. The research highlights, therefore, that it is beneficial for a company, as part of a greater supply chain strategy, to include and quantify GSCM (Beamon 1999; Khoo, Bainbridge, Spedding and Taplin 2001; Sarkis 2002; Rao and Holt 2005; Capusneanu 2008; Tsai *et al.* 2010; Kumar *et al.* 2011; Lee and Cheong 2011; Ubeda *et al.* 2011; Wang *et al.* 2011; Bose and Pal 2012; Jain and Sharma 2014).

The research methodologies used were mostly case studies and model building (Figure 18). Case studies were performed mainly in the automobile manufacturing environment. The modelling methodology includes evolutionary game theory, fuzzy goal programming, dynamic non-linear multi attribute decision modelling, and empirical testing of GSCM competitiveness, and ECP. The areas in the supply chain that the research mainly addresses are *source, make*, and *deliver* (Figure 19). The regulatory side of GSCM was not addressed in the research articles in the matrix; it is still a new concept that requires on-going research, as the laws are changing to address global warming and environmental awareness. Most of the research articles focus on the manufacturing industry, which includes a high number of automobile, components, and parts manufacturing companies (Figure 20).

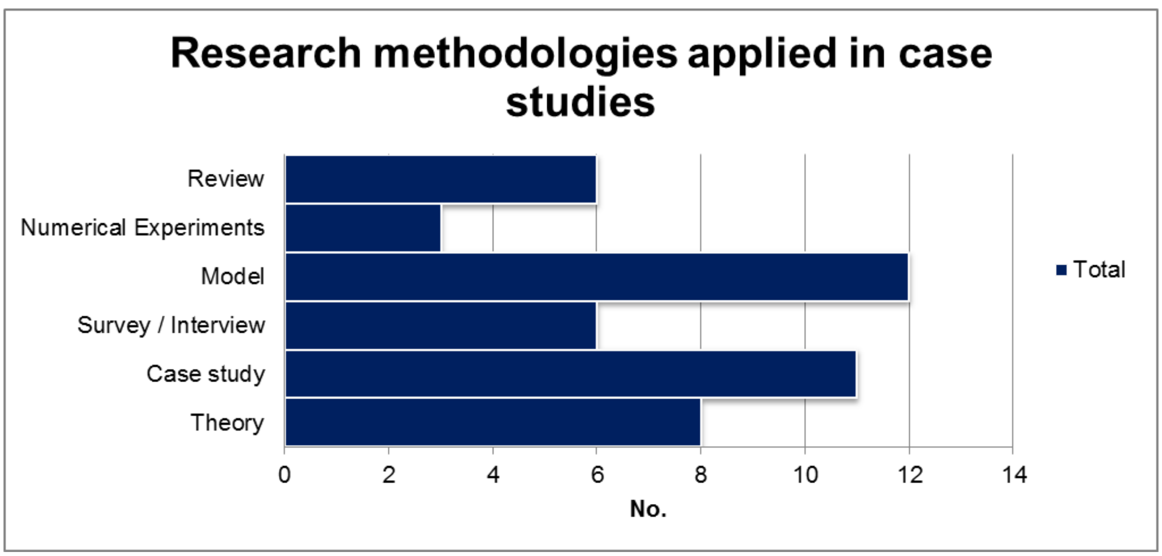


Figure 18: Research methodologies applied in the summarised case studies

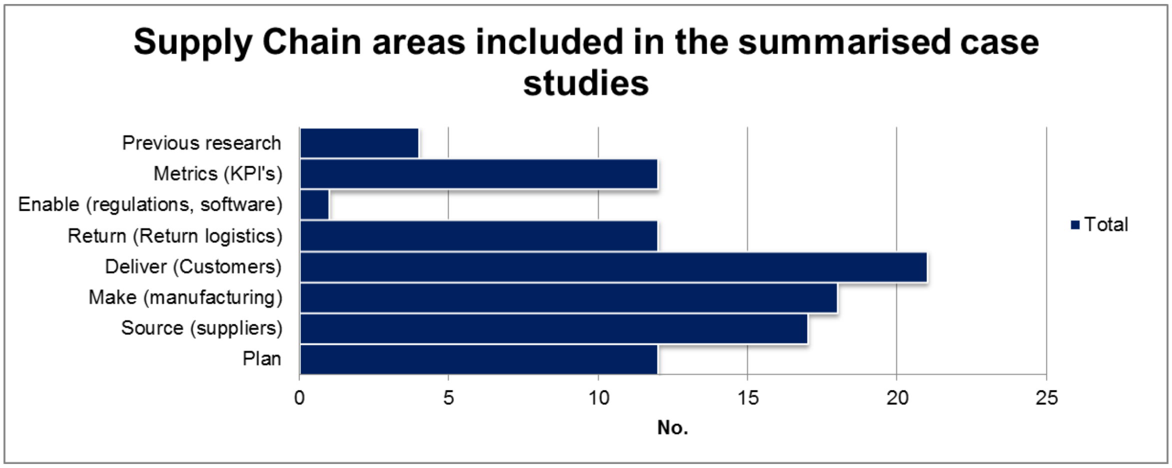


Figure 19: Supply chain areas included in the summarised case studies

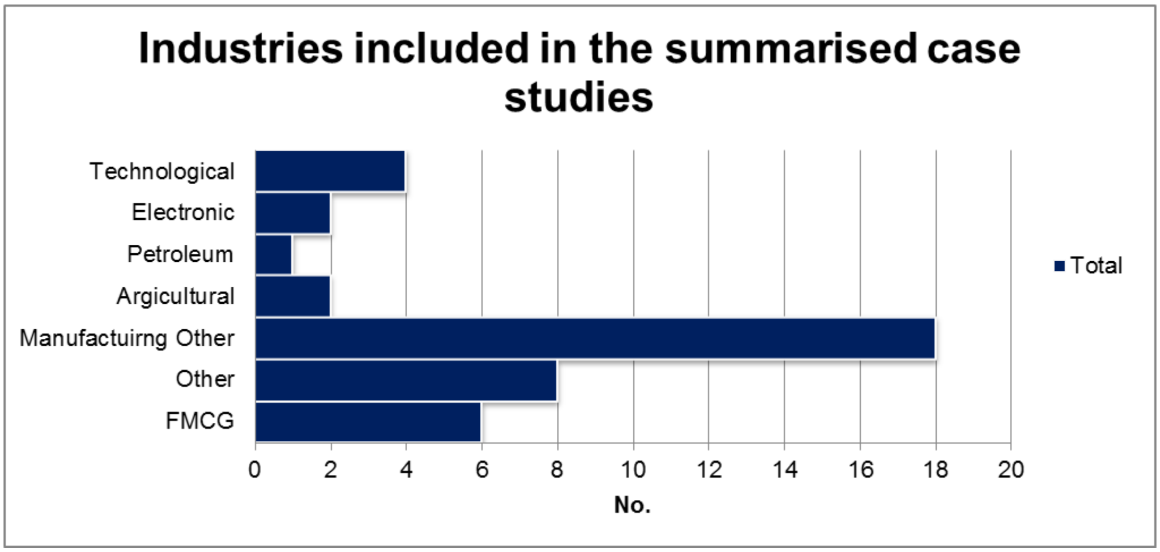


Figure 20: Industries included in the summarised case studies

From the research and matrix summary it is clear that only a few models address the full end-to-end supply chain view, which includes the *plan, source, make, deliver, return*, and *enable* functions. Barari *et al.* (2012) developed a two-player game to illustrate the concept of passing on to the consumer all the extra costs that the producer experiences in greening the supply chain. Sundarakani *et al.* (2010) developed a model that measures carbon emissions across the supply chain, while Olugu *et al.* (2011) developed a set of measures to evaluate green supply chain performance that must still be tested in a practical environment. Toke *et al.* (2010) summarised the operational and environmental factors across the supply chain that contribute to operating a green supply chain. Chaabane *et al.* (2012) implemented the LCA approach in a mathematically-based model to assist with sustainable supply chain design, and concluded that LCA principles aid in developing sustainable supply chains. Kumar *et al.* (2011) applied the Du Pont analysis to two companies' secondary data, and concluded that implementing green supply chain initiatives can be financially beneficial for a company. Van Hoek (1999) identified implementation steps for suppliers, manufacturers, wholesalers, distributors, and retailers for GSCM initiatives. Jooste and Van Niekerk (2009) and Ernst and Young (n.d.) concluded that the ABC method can be used to assess the full end-to-end supply chain cost, while Tsai *et al.* (2010) and Capusneanu (2008) confirmed that the impact of environmental costs on product costing can be analysed by applying the ABC method.

Although some of the articles conclude that implementing green supply chain initiatives can be financially viable by applying various methods to understand the environmental and cost impact on the supply chain, none quantify the impact on the profitability of a business when implementing these initiatives. To realise the full benefit of implementing GSCM, the whole supply chain must be analysed from end-to-end to understand the total impact. Activities in the supply chain influence each other in a positive or a negative way, and it is necessary to view the whole supply chain to ensure that the optimisation of one function will not be to the detriment of another function in the supply chain, but rather that it will benefit the supply chain as a whole (Clift and Wright 2000). The research conducted supports the need to answer the research question – that is, to determine how the impact on business profitability and sustainability of implementing environmental initiatives can be quantified in a South African business.

2.3 Conclusion of earlier research

Srivastava (2007) concluded that most of the research into GSCM and optimisation was conducted in different parts of the world, with limited interaction between researchers. Most of the research has been at a theoretical research level, reflected in papers and frameworks. Srivastava (2007) proposed that the way forward for green supply chain research is a practical framework that can determine the optimal way a company must select initiatives and products to maximise profitability, while also keeping in mind the protection of brand integrity. Srivastava (2007) proposed that, for overall GSCM and supply chain design, a combination of traditional and new techniques, along with various tools, is needed. This is what the framework presented in this document seeks to offer.

The following key points from the literature study can be summarised:

- Only a few models address the full end-to-end supply chain view, which includes *plan*, *source, make, deliver, return*, and *enable*.
- The depth of GSCM research varies per category and study performed.
- The focus of GSCM in companies falls into three different categories: environmental performance, economic and social responsibility focus.
- Performance measures can be used to assess supply chains.
- Some of the hierarchical network models developed cannot be used in daily business operations and strategic decision-making.
- Different factors need to be considered in the supply chain, as well as their influence on each other.
- Carbon emissions tracking has been implemented in certain businesses, but it should be noted that carbon emissions are clearly not the only form of environmental assessment. Nevertheless, carbon emissions' tracking is a popular way to measure environmental sustainability, and is easy to understand.
- The ABC method can be used to assess the full end-to-end supply chain cost.
- There are a multitude of opportunities to develop new models, articles, frameworks, and theories about GSCM.
- A gap has been identified for analytical tools to quantify GSCM, linking sustainability and impact on business profit.
- GSCM can enable competitive advantage and ECP.
- A full end-to-end supply chain view must be used for GSCM to ensure that the initiative benefits the whole supply chain, and that costs are not added to other parts of the supply chain when a GSCM initiative is implemented

The research has suggested that there is a need to quantify the impact of implementing green supply chain initiatives in a company, based on the profitability and sustainability of that company's supply chain. Existing methods that are used to assess the business profitability and sustainability impacts of initiatives are not focused on monitoring the complete supply chain, from operational activities to longer-term strategic initiatives (Porter and Van der Linde 1999; Schaefer and Kosansky 2008; Marchal *et al.* 2011). Carbon emissions will be used as a measure of the impact on sustainability, and will be combined with the ABC method to understand the impact on profitability as well.

The analytical framework will aim to help a company to evaluate the financial and environmental impact of sustainability initiatives, to make strategic decisions about improving the business' environmental impact, and to operate in such a way as to gain competitive advantage in its markets. The end-to-end supply chain view can aid the understanding of GSCM from a wider perspective, and can assist the business to be more responsive and more aware of the impact of business decisions on the supply chain. Business profitability impact will be used to evaluate the supply chain, rather than performance measures, due to the greater impact it will have on the supply chain.

From the research it is clear that there is no single framework that addresses both profitability and sustainability at the same time. The Green Business Profitability Framework presented in this paper combines different elements into one ANP to quantify the financial and environmental impact of GSCM initiatives in business (Lessner 1991; Jooste and van Niekerk 2009; Dawson Consulting n.d.; Ernst and Young n.d.; DEFRA, n.d.).

The key findings of the existing frameworks – and their relevance to the analytical framework – are summarised below:

- The EUISSCA's Sustainable Supply Chain framework will be incorporated into the basis of the developed ANP to understand the process of moving from compliance to leadership. A shortcoming of this model in the context of quantifying GSCM is that the cost of going green is not considered, as the model is focused more on compliance.

- As stated by Cash and Wilkerson (2003), the GreenSCOR model's advantages lie in its ability to link carbon emissions to a specific process, to aid efficiency improvement in the supply chain, to aid linking specific strategic carbon emission initiatives to activities, and to identify the root cause when environmental targets are not met. These attributes will be valuable when analysing the total environmental impact of the supply chain.

- The Toyota 5R framework will not be a suitable model for quantifying the impact of environmental initiatives on business profitability and sustainability, but it is suitable tool for quantifying waste in a process. The concepts of *refine, reduce, reuse, recycle*, and *retrieve* energy can be used to identify other green options in the rest of the supply chain, and will be used in the analytical framework to identify green measures that must be quantified, and to group initiatives.

- The LCA method quantifies the environmental impact in different categories, and so will not be suitable for addressing the research question. The LCA model's output will be used as the input to the developed model by incorporating all the building blocks in a systematic process overview (De Beer and Friend 2006). The LCA only measures environmental impact, not the impact on profitability; but it is the latter that the research question needs to address (De Bruijn *et al.* 2004).

- De Beer and Friend (2006) conclude that the EEGECOST model is highly suitable for quantifying the environmental costs per functional unit. The environmental costs are compared on an annual basis to understand their impact on direct and indirect production environmental initiatives. The EEGECOST only focuses on production and on activity related to the production of a functional unit, and does not model the impact on profit and on the rest of the supply chain – unlike the aim of the developed framework.

- The case studies by Kumar *et al.* (2011) show that there is a need to measure the impact of green supply chain initiatives on profitability, and the Du Pont analysis can be a suitable method – although it does not provide lower-level data, and does not specify what part of the supply chain contributed to the increase in profitability. In order to answer the research question on a total company level, the Du Pont method can be used, but this will only indicate the utilisation of resources, which will not necessary mean that environmentally-friendly initiatives are implemented; it could also just mean that the business is more productive. So the Du Pont method is not accurate enough to answer the research question.

From the research it is clear that none of the models and frameworks investigated will be suitable to compare against the developed framework. The GreenSCOR model comes closest, but it does not quantify the financial impact. Therefore it will not form part of the basis of the developed framework. The GreenSCOR metrics will be converted into carbon emissions per process with the assistance of the DEFRA (n.d.) carbon emission conversion factors. This will make it possible to calculate the end-to-end supply chain carbon footprint, and so to calculate the environmental impact of the supply chain. Other elements that will be incorporated into the developed framework are LCA, product costing, 'cost to serve', ABC, and Defra (Lessner 1991; Jooste and van Niekerk 2009; Dawson Consulting n.d.; Ernst and Young n.d.; DEFRA n.d.). The precise steps to be followed are explained in more detail in Chapter 3, and the practical application of the framework is developed in Chapter 4.

Chapter 3: Framework Design

The research presented in chapter 2 identified a gap in the analytical tools used to quantify green supply chain management (GSCM). The framework will be developed using the previous research as well as case studies. Theory-building will be the largest part of the method, followed by theory-testing research and theory-application research. Data will be tested through the use of multiple case studies at a specific fast moving consumer goods (FMCG) company in South Africa.

3.1 Framework Design

From the research it was established that various frameworks and theories assess different parts of the supply chain. The researched frameworks do not evaluate the full profitability and environmental impact of implementing green initiatives in the supply chain; therefore there is a need to develop a new framework (Porter and Van der Linde 1999; Srivastava 2007; Schaefer and Kosansky 2008; Marchal *et al.* 2011). The framework presented in this document will consider and combine elements of the life cycle assessment (LCA) method, the value-added approach (VAA), supply chain operations reference model (SCOR), product costing, 'cost to serve', activity-based costing (ABC), business profitability, and the green supply chain operations reference model (GreenSCOR). The framework will aim to quantify the financial and environmental effect of GSCM initiatives (Lessner 1991; Jooste and Van Niekerk 2009; Dawson consulting n.d.; Ernst and Young n.d.).

3.1.1 Phase 1: Framework Development

The development of the framework will begin by using the SCOR methodology to segment the supply chain building blocks into *plan, source, make, deliver, return*, and *enable* activities (Supply Chain Council (SCC) n.d.). The *source, make*, and some *enable* activities will contribute towards product costing, while the *deliver, return*, and some *enable* activities will fall under the 'cost to serve' section. The *plan* activities will fall under both product costing and 'cost to serve' sections. With the help of the SCOR methodology building blocks, the framework uses the end-to-end supply chain flow and arranges cost centres of a company into receiving, storage, processing, delivery, sales, marketing, administration, overheads, and advertising. The LCA model's methodology of incorporating all the building blocks into a systematic process overview is applied to group the cost centres into a supply chain view (De Beer and Friend 2006). The VAA analysis, which will be used to identify the environmental issues associated with activities, will be addressed in chapter 4 as part of the case study application (Ellis 2007).

To shift from the conventional method of calculating product profitability to calculating the profitability per product type and customer, however, requires a detailed allocation of labour, machine, space, and other variable costs. The Rand per unit value is not just an understanding of the profitability, but also an indication of the main cost drivers of the product. Figure 21 illustrates the approach followed to determine first the product costing and then the 'cost to serve' portion of the project, based on ABC cost analysis as the primary driver behind the developed framework. Product cost will include raw material receiving, raw material storage, and processing (production) cost. 'Cost to serve' includes finished goods storage, delivery, sales, marketing, administration, overheads, and advertising costs.

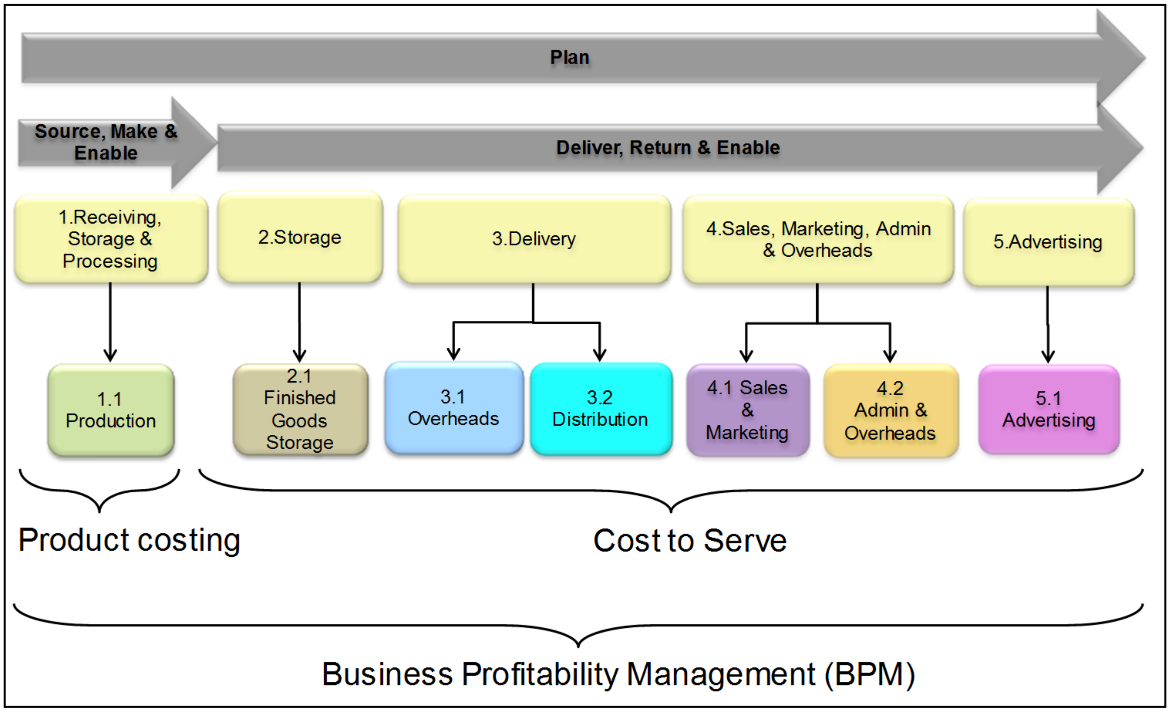


Figure 21: Approach followed to determine product costing and 'cost to serve'

The different activities across the supply chain, from receiving to dispatch, are grouped into work centres for which costs must be calculated. These work centres will serve as the base level of costing. Work centre cost drivers must be aligned between key stakeholders and identified before the cost can be allocated per product type. Products are grouped into levels to which different costs are allocated, depending on manufacturing activities and the number of units being dealt with. The product levels are dependent on the product type – for example, the category, major group, and sub-group of a product. Once the product cost has been calculated, the cost is linked to different customers, using the actual sales data as reference, which is the 'cost to serve' part of the framework.

This approach can benefit a business by making visible the non-value-added activities and biggest cost contributors. Also, the approach can improve overall profitability by monitoring and reporting total life-cycle cost and product performance. The overall process of budgeting by identifying the cost per performance relationships for different customers and product types can also be improved (Tsai *et al.* 2010).

The ABC cost analysis also comes with a few challenges in terms of allocating overhead costs. The overhead costs can be difficult to split or allocate per function. In this case the overhead costs that cannot be allocated will be split according to volumes across customers, DC, products etc. This will ensure that the model always balance back to the first overall level of costing.

3.1.1.1 Production

The production cost consists of the direct cost of cost of goods sold (COGS) and manufacturing overhead (MOH) costs. Direct COGS are all the costs associated with the physical production process. The total cost per supply chain area is divided by the number of units produced by each to calculate a unit rate (Rand per unit) per platform. COGS can include the company's own production costs as well as those of products manufactured by a co-manufacturing company, if a company uses both options. A co-manufacturing company is one that makes products under contract on behalf of a company, and will charge a cost-per-unit to manufacture the product. MOH can include MOH fixed, MOH variable, and MOH support (see Figure 22).

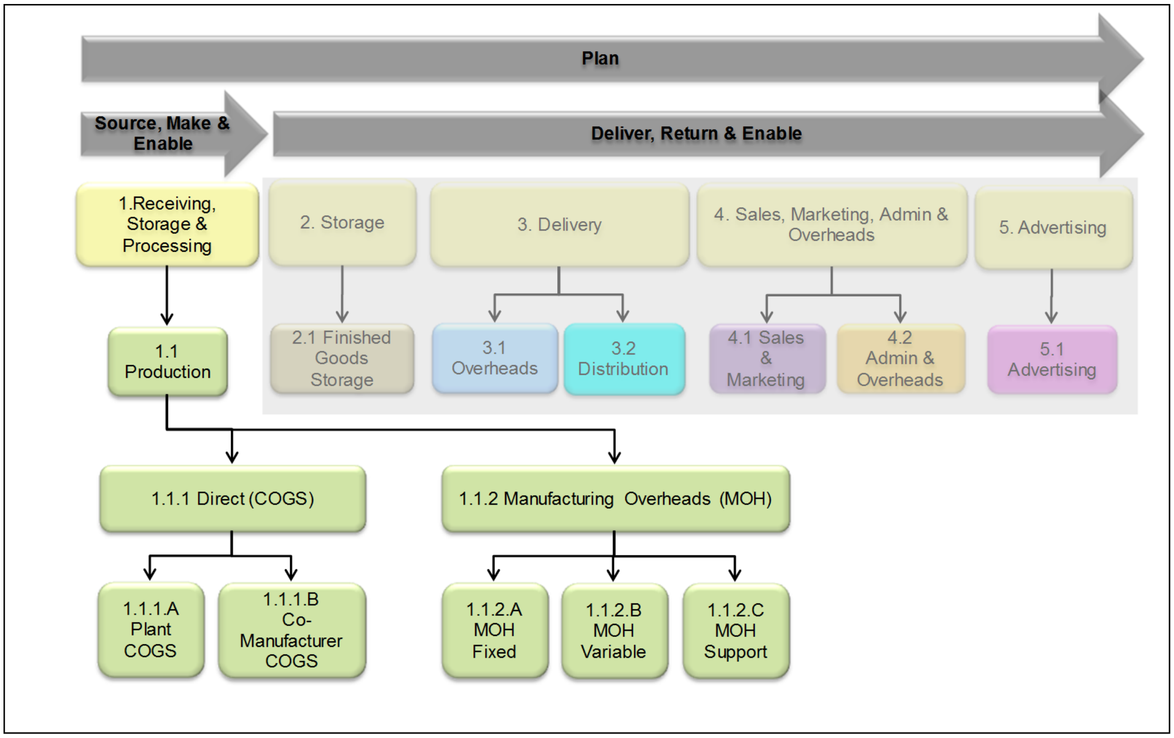


Figure 22: Receiving, storage, and processing detail

Figure 23 explains the detailed calculation of the direct COGS. The COGS of production ('plant COGS') use the actual rand per unit per supply chain area and multiply it by the number of units produced. COGS include the costs and transportation of raw materials, plus all the other costs associated with production that is not accounted for under the MOH cost.

Co-manufacturing COGS are all the production costs incurred by a possible co-manufacturer, and can be calculated using the Rand per unit fee charged by the co-manufacturer, multiplied by the number of units produced. There can be price variances (PPVs) per co-manufacturer due to market situations, raw material price fluctuations, and so on; and these will be incorporated by deducting the difference in price from the total selling price to the co-manufacturer to reveal the true spend.

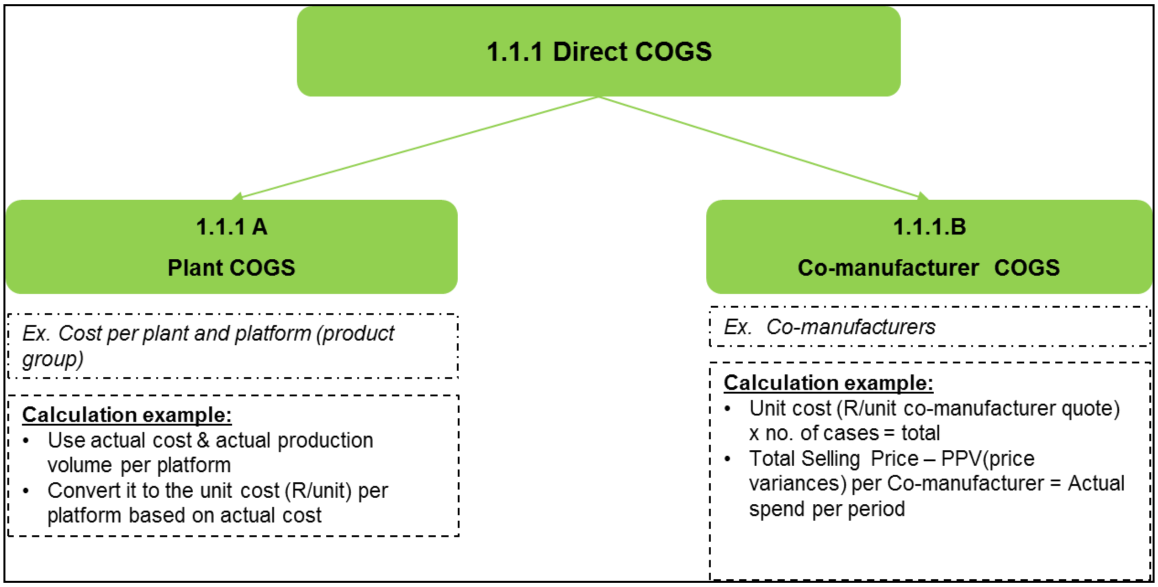


Figure 23: Direct COGS cost breakdown and detail

The MOH costs consist of fixed, variable, and support costs. Fixed MOH costs can include building, rent, cleaning, quality control, labour, building repairs, maintenance, and manufacturing facility storage costs. The variable costs are those that change with the amount produced, and can include electricity, plant natural gas, water, plant fuel and oil, plant sewage, other utilities, telephone, operating supplies, overtime, and volume adjustment costs. MOH support costs are associated with production support functions, and can include purchasing, quality, raw material management, and manufacturing management costs. The unit rates are calculated by dividing the total cost centre cost by the number of units produced. The number of units is calculated using the sales data per product type (see Figure 24).

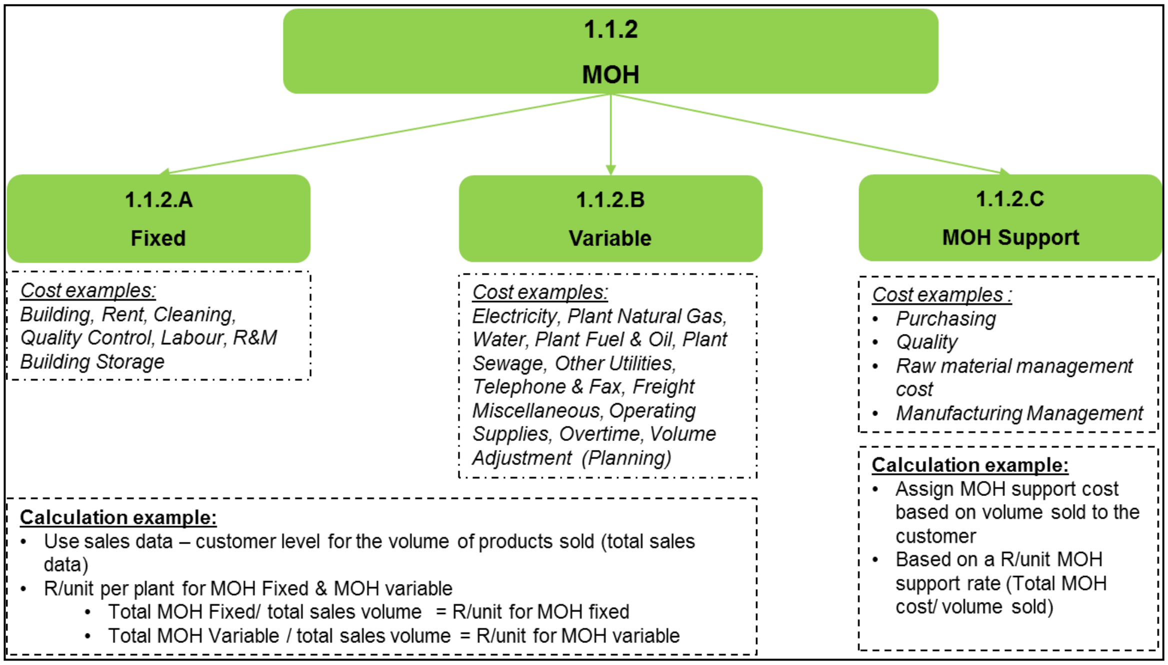


Figure 24: MOH cost breakdown and detail

3.1.1.2 Storage

The storage cost breakdown is illustrated in Figure 25. The storage cost is the finished goods costs for storing and moving products through the central distribution centres (CDCs) and distribution centres (DCs). The CDC and DC costs are divided into fixed and variable costs. Fixed costs include all those associated with the administration and overheads of the facilities, and will not vary with the number of products handled. It can include compensation, employee benefits, equipment, other headcount-related costs, and operating expenses. Variable costs are associated with the handling and storage of products, and can include handling equipment rental and allowances; depreciation, facility cost, etc. (see Figure 26). The costs (fixed and variable) are calculated by dividing the total cost by the total number of cases handled for the same period in the facility. Any type of fixed or variable cost can be accommodated in the framework.

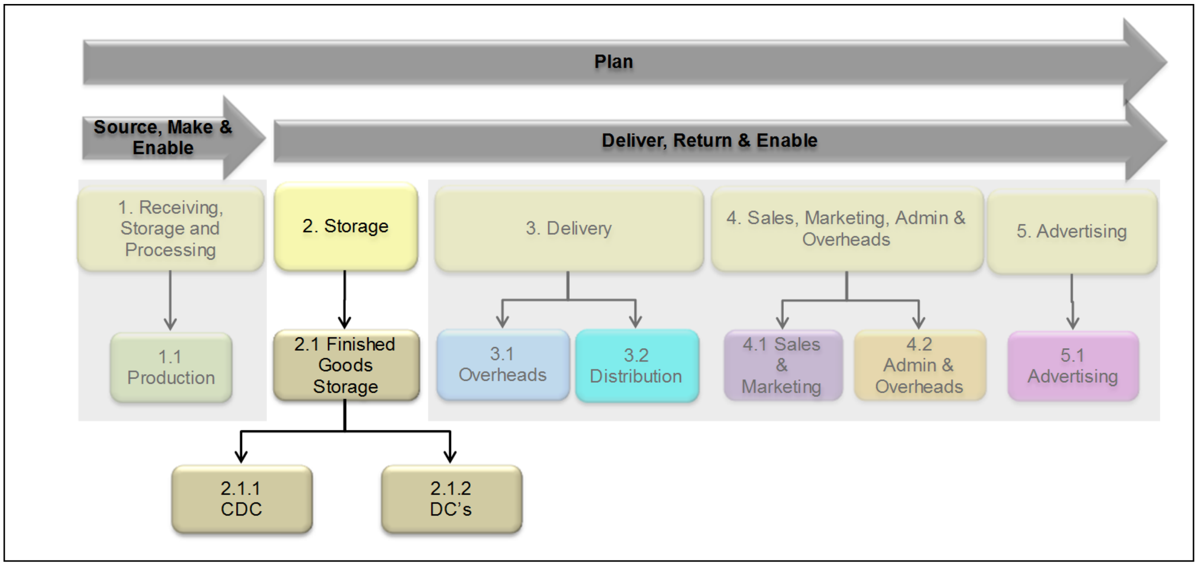


Figure 25: Finished goods storage detail

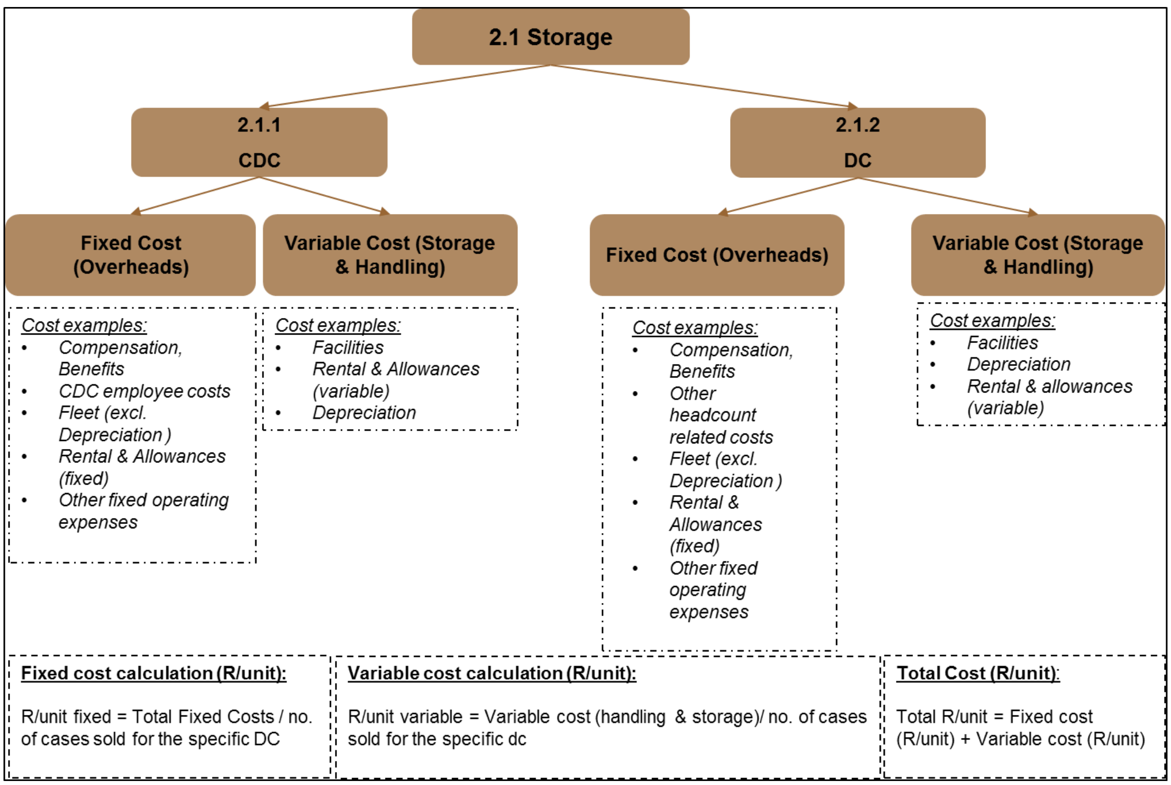


Figure 26: Storage cost breakdown and calculation

3.1.1.3 Delivery

Figure 27 illustrates the delivery cost breakdown details. The delivery cost can be broken down into overheads and distribution cost. The overhead costs are the cost of management and any other cost not directly related to primary or secondary distribution costs. Figure 28 illustrates the detailed breakdown of the primary distribution cost per route, and return costs are also calculated for all returns of pallets, cartons, stale products, and any other products that must be returned. The secondary distribution costs are divided into fixed and variable costs. Fixed costs can include fleet, overheads, equipment, rental, and insurance. Variable costs vary with the number of kilometers driven. It can include fuel, oil, tyres, repairs, maintenance, E-tolls, depreciation, traffic fines, and driver salaries. The fixed and variable costs are assigned to a product type and customer based on the percentage of the truck capacity and sales volume of the route that customer and product will consume. The reason for the percentage allocation is that a number of customers are assigned to a route ordering various products. The overhead costs are assigned by dividing the total overhead cost by the number of units sold to calculate a unit rate (Rand per unit) (see Figure 29).

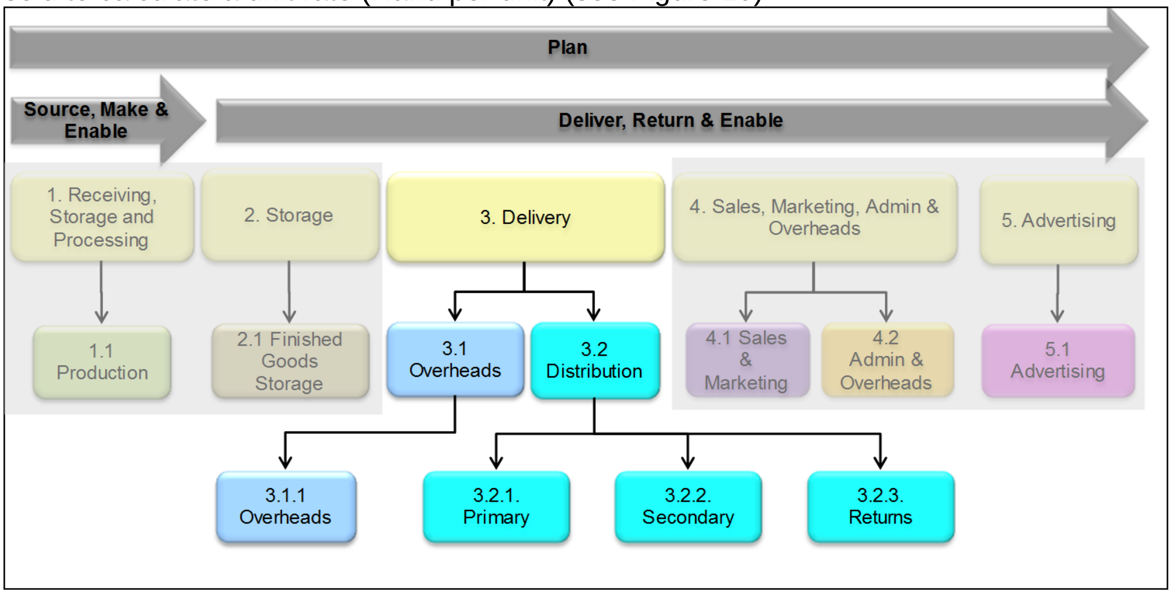


Figure 27: Delivery detail

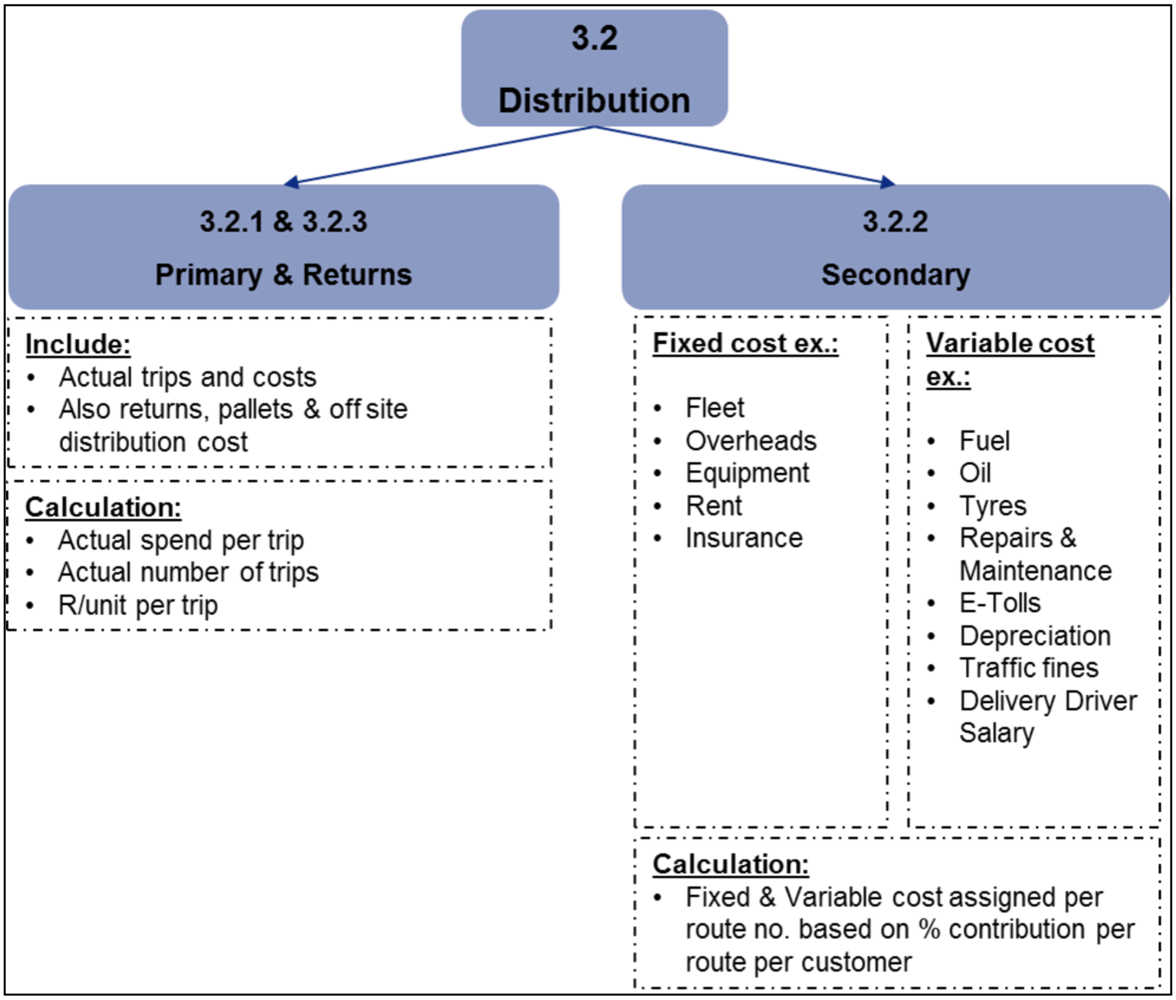


Figure 28: Distribution cost breakdown and detail

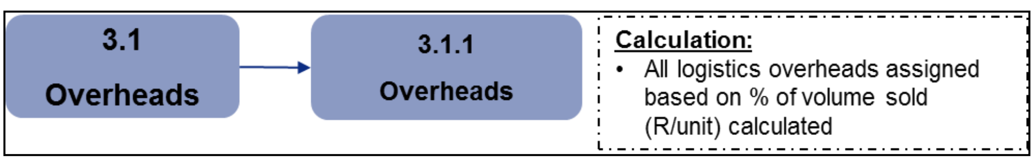


Figure 29: Overhead cost breakdown and detail

3.1.1.4. Sales, Marketing, Administration, and Overheads

The sales, marketing, administration, and overhead costs are illustrated in Figure 30. Sales and marketing costs include overhead and other costs. Overhead costs include all sales and marketing overhead costs. Other costs can include national account management and trade marketing. The number of units sold and the brand of the product will drive a portion of the sales, marketing, administration and overhead cost that must be assigned. The brand will determine what amount of advertising and marketing is spent on the brand, and can differ between brands. If the brand is a core brand of the business, it will incur higher investment costs (see Figure 31).

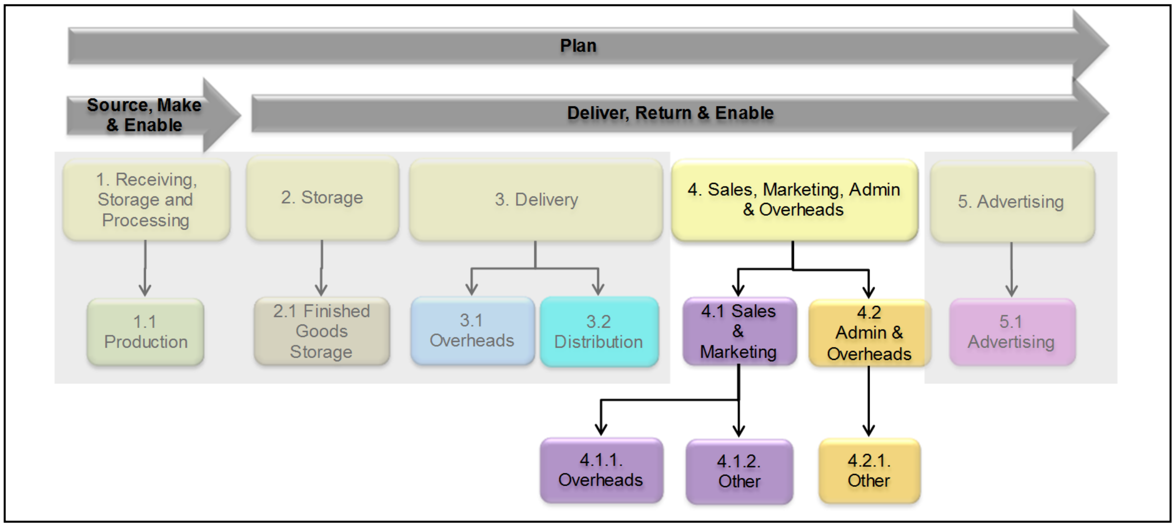


Figure 30: Sales, marketing, administration, and overheads detail

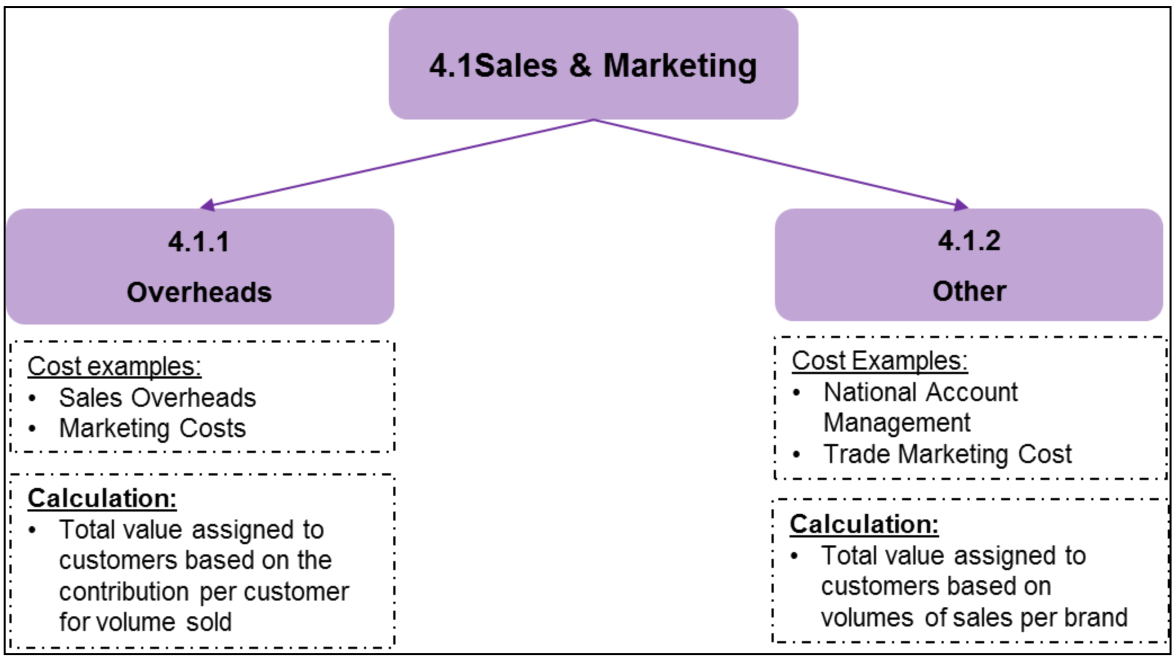


Figure 31: Sales and marketing detail

The administration and overheads costs can include training overheads, human resources, executive costs, research and development, finance, sales and distribution general costs, and supply chain general costs. These are all associated with management; control, and training within functions in the business (see Figure 32). The total cost will be divided based on the number of units sold.

4.2 Admin & Overheads

Cost examples:
- Training Overheads
- Human Resources
- Executive Costs
- Research & Development
- Finance
- Sales and Distribution General and Admin Cost
- Supply Chain General and Admin Cost

Calculation:
- Total value assigned to customers based on the contribution per customer for volume sold

Figure 32: Administration and overhead costs

3.1.1.5 Advertising

Figure 33 illustrates how the advertising cost can be divided into insights and sub-business levels 1, 2, and 3. The sub-business level is the cost associated with advertising the different brands. Insights are research that is focused on consumer insights and market needs. A business can adapt the advertising cost by populating the different sub-levels; and if there are no insights costs, the business can leave it blank (see Figure 34).

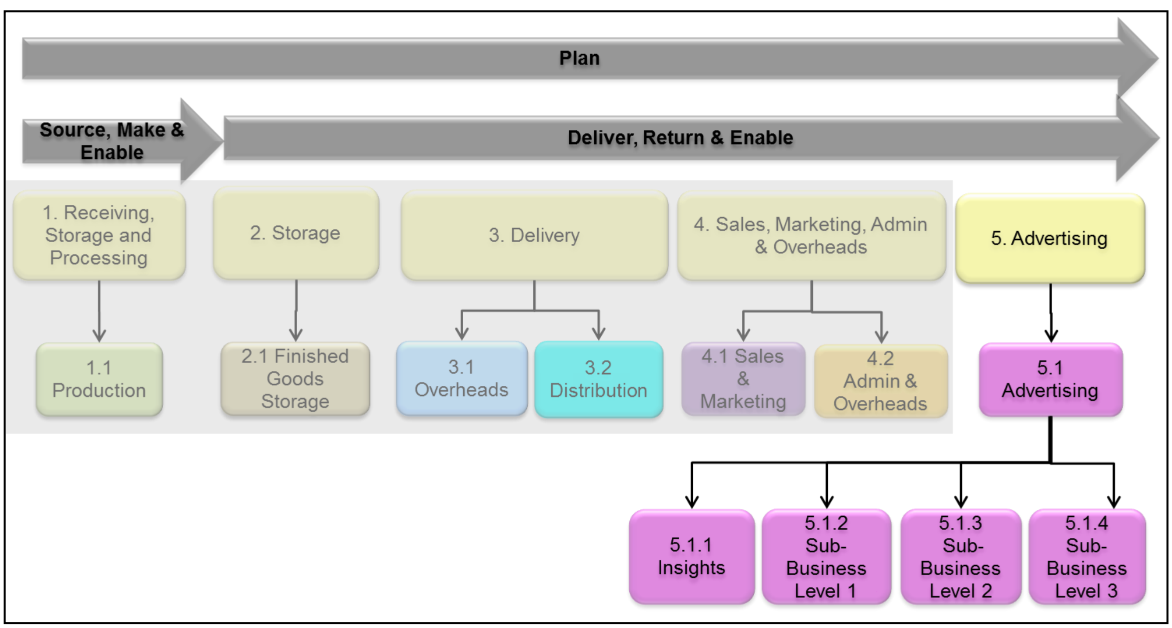


Figure 33: Advertising detail

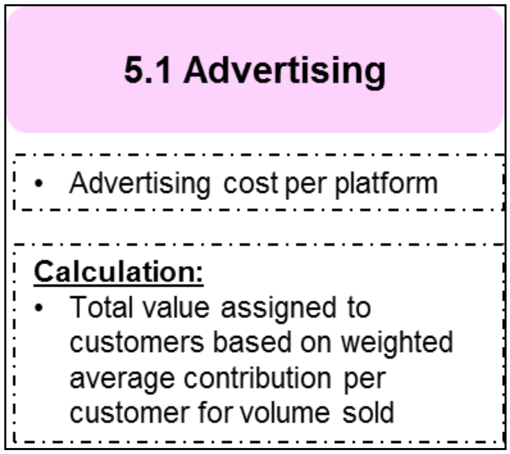


Figure 34: Advertising cost

3.1.1.6 Phase 1 Summary

All costs relating to the operations can be calculated and split according to the activities with which they are associated. All overhead expenses can be split proportionately across the activities. From these calculations, the actual cost per unit by product type and by customer can be calculated. Jooste and Van Niekerk (2009) and Ernst and Young (n.d.) report that the full end-to-end supply chain cost can be determined by applying the ABC method to analyse the supply chain. The partial framework developed during phase one already includes elements of the ABC method, product costing, 'cost to serve', LCC, and a partial SCOR methodology. The full product costing and 'cost to serve' part of the framework, along with all cost classification, is presented in Figure 35 below.

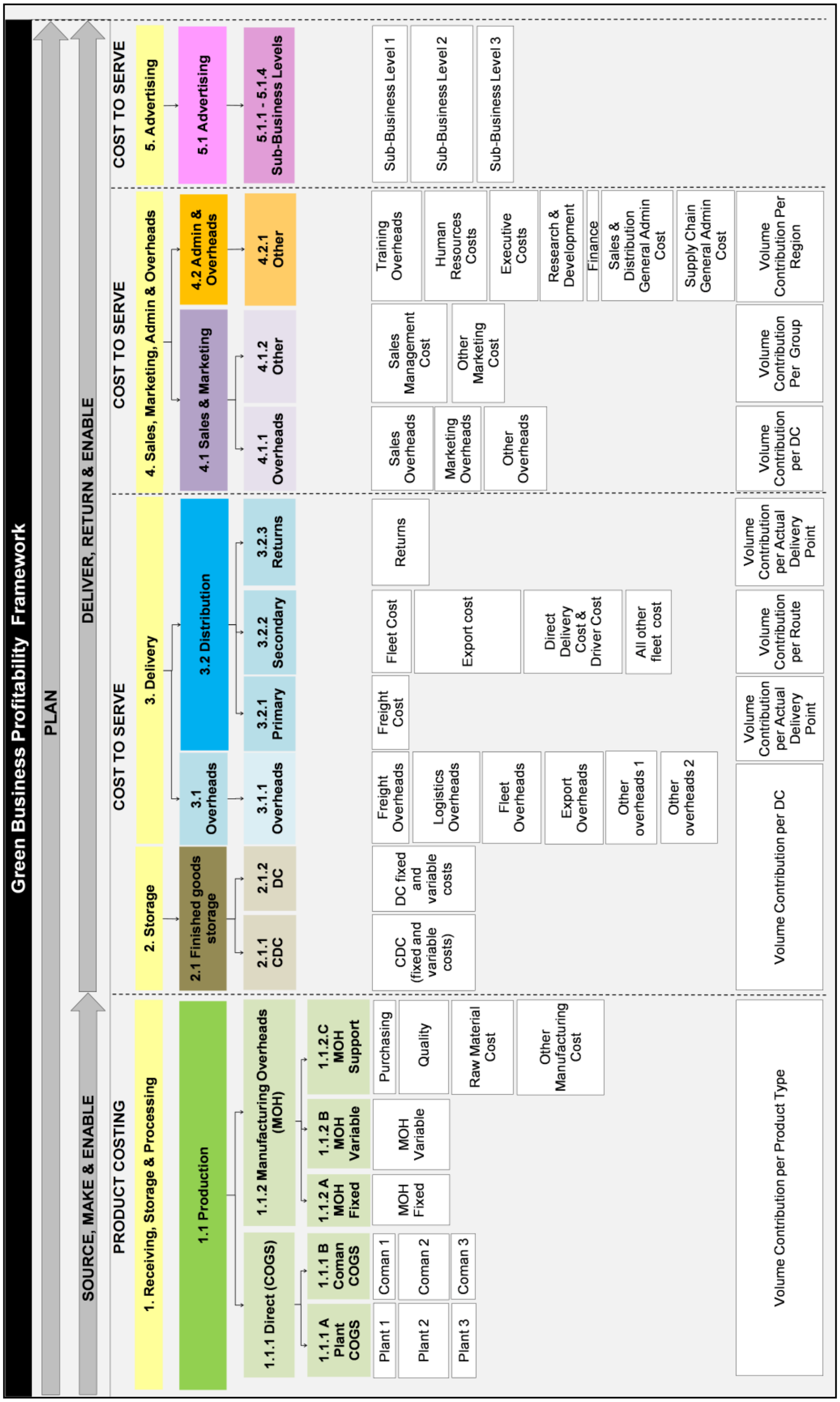


Figure 35: Product costing and ‘cost to serve’ detail

3.1.2. Phase 2: Business Profitability and GreenSCOR

3.1.2.1 Business Profitability Modelling (BPM)

The Green Business Profitability Framework will be used to determine the cost of different business levels by calculating costs as described in the section above on the supply chain. Once the costs have been calculated, the business profitability needs to be incorporated into the framework. Figure 36 shows the current view that businesses have of their gross profits, and how they divide them into segments. Currently all expenses are grouped together and subtracted from the gross profit (GP) to calculate the net profit (Jooste and Van Niekerk 2009).

The Green Business Profitability Framework calculates business profitability differently, using the approaches used by Jooste and Van Niekerk (2009) and Ernst and Young (n.d.) – that is, by splitting all the revenues and cost per product across all customers for the product costing and 'cost to serve' sections of the framework (see Figure 35). In this way, individual customers' and products' contributions to profitability can be derived. Once these splits are made, various GPs are calculated to determine the break-even point for various products and customers. This can assist with detailed supply chain analysis and help to identify areas for improvement. Different GP levels can be analysed, depending on the requirements of industry and management.

Current Calculations:

Revenue
Less Cost of Goods Sold (COGS)
Gross Profit (GP)
Less Other Expenses
Net Profit/Loss

Product Costing

Revenue
Product A Revenue
Product B Revenue
Less Cost of Goods Sold
Product A COGS
Product B COGS
Gross Profit
Product A GP
Product B GP
Less Other Expenses
Product A Expenses
Product B Expenses
Net Profit/Loss
Product A Profit/Loss
Product B Profit/Loss

Cost to Serve

Revenue
Product A, Customer A Revenue
Product A, Customer B Revenue
Product B, Customer A Revenue
Product B, Customer B Revenue
Less Cost of Goods Sold
Product A, Customer A COGS
Product A, Customer B COGS
Product B, Customer A COGS
Product B, Customer B COGS
Gross Profit
Product A, Customer A GP
Product A, Customer B GP
Product B, Customer A GP
Product B, Customer B GP
Less Other Expenses
Product A, Customer A Expenses
Product A, Customer B Expenses
Product B, Customer A Expenses
Product B, Customer B Expenses
Net Profit/Loss
Product A, Customer A Profit/Loss
Product A, Customer B Profit/Loss
Product B, Customer A Profit/Loss
Product B, Customer B Profit/Loss

Gross Profits

Revenue
Less Cost of Goods Sold (COGS)
Gross Profit 1 (GP1)
Less Storage
Gross Profit 2 (GP2)
Less Delivery
Gross Profit 3 (GP3)
Less Sales & Marketing
Gross Profit 4 (GP4)
Less Admin & Overheads
Gross Profit 5 (GP5) (Net Profit Before Tax)

Figure 36: The detailed gross profit approach in the developed framework of splitting gross profits

Incorporating both the product costing and the 'cost to serve' methodologies – while also adding gross sales revenue, discounts, and allowances – will result in an end-to-end business profitability model. Depending on the maturity level of the company's data, this can seem like a very data-intensive exercise; but using Microsoft Excel's automation tools or a database will make this task manageable. In future, the aim could be to automate the calculations once the process has been finalised. The intensity will also decrease exponentially by decreasing the level of detail of data required. For example, if the 'cost to serve' per product per customer per route is not required, the cost per product would be sufficient. This example focuses on the lowest level of the framework; but it can also be applied to less detailed data.

Using the framework discussed in phase 1, the gross sales, discounts, and allowances will be added to the framework. The product costing and 'cost to serve' will be deducted from the net profit to arrive at profitability on a detail level per customer. The levels of profitability that can be analysed include the overall business level, the sub-business level (local and export), sales regions, go to market (GTM) methods, major customer groups, CDC, DC, brand, route, and customer (see Figure 37). The ability to analyse profitability on all the different levels will enable a business to understand the true profitability per customer, product, route, etc.; and it can then act accordingly to improve business profitability. This will enable a business not to view profitability only on a total business level, but rather to arrive at a detailed number – and also to be aware of the direct impact of this number.

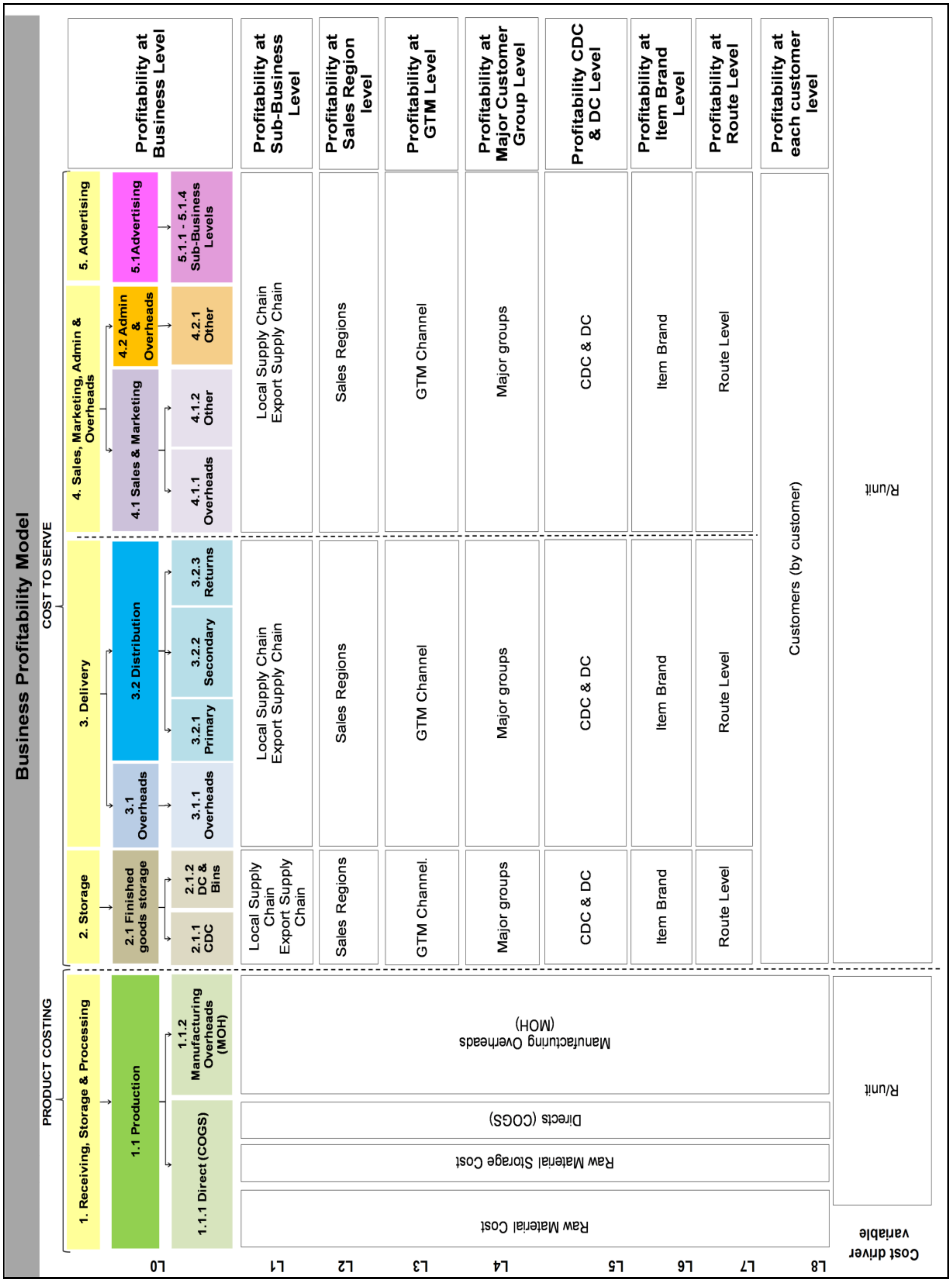


Figure 37: Business profitability framework and levels

3.1.2.2 GreenSCOR

GreenSCOR metrics are incorporated into the framework to quantify total supply chain carbon emissions, and thus to quantify the environmental impact of GSCM; while the methods, product costing, 'cost to serve', and business profitability, used in conjunction with each other, will quantify the financial impact. The GreenSCOR metrics will be converted into carbon emissions using Department of Environment, Food, and Rural Affairs (DEFRA) (n.d.), and will be incorporated into the framework at the different levels.

The best practices for GreenSCOR (as summarised per process in section 2.2.2.2 and Appendix B) will be incorporated into the framework once the carbon emissions are known in the supply chain. They will then be a source of ideas to optimise the environmental output of the supply chain by reducing carbon emissions. Best practices for the *plan* process include *minimise energy use*, *minimise packaging*, *maximise loads*, and *minimise the returns*. The framework will be able to estimate the cost implication when implementing best practices, to determine what impact they might have on the profitability of the product. The framework will be helpful when making strategic decisions and running various scenarios. It will make it possible to understand the predicted financial impact on the various cost centres in the framework. For example, to model the impact of moving a DC location, resulting in increased travelling distances to customers, primary and secondary transport costs – which fall under the distribution cost centre – will rise.

Figure 38 illustrates the complete framework with the GreenSCOR metrics and best practices added. The framework will be used in a series of case studies at a single company in an attempt to answer the research question. The newly-developed framework is called the 'Green Business Profitability Framework'.

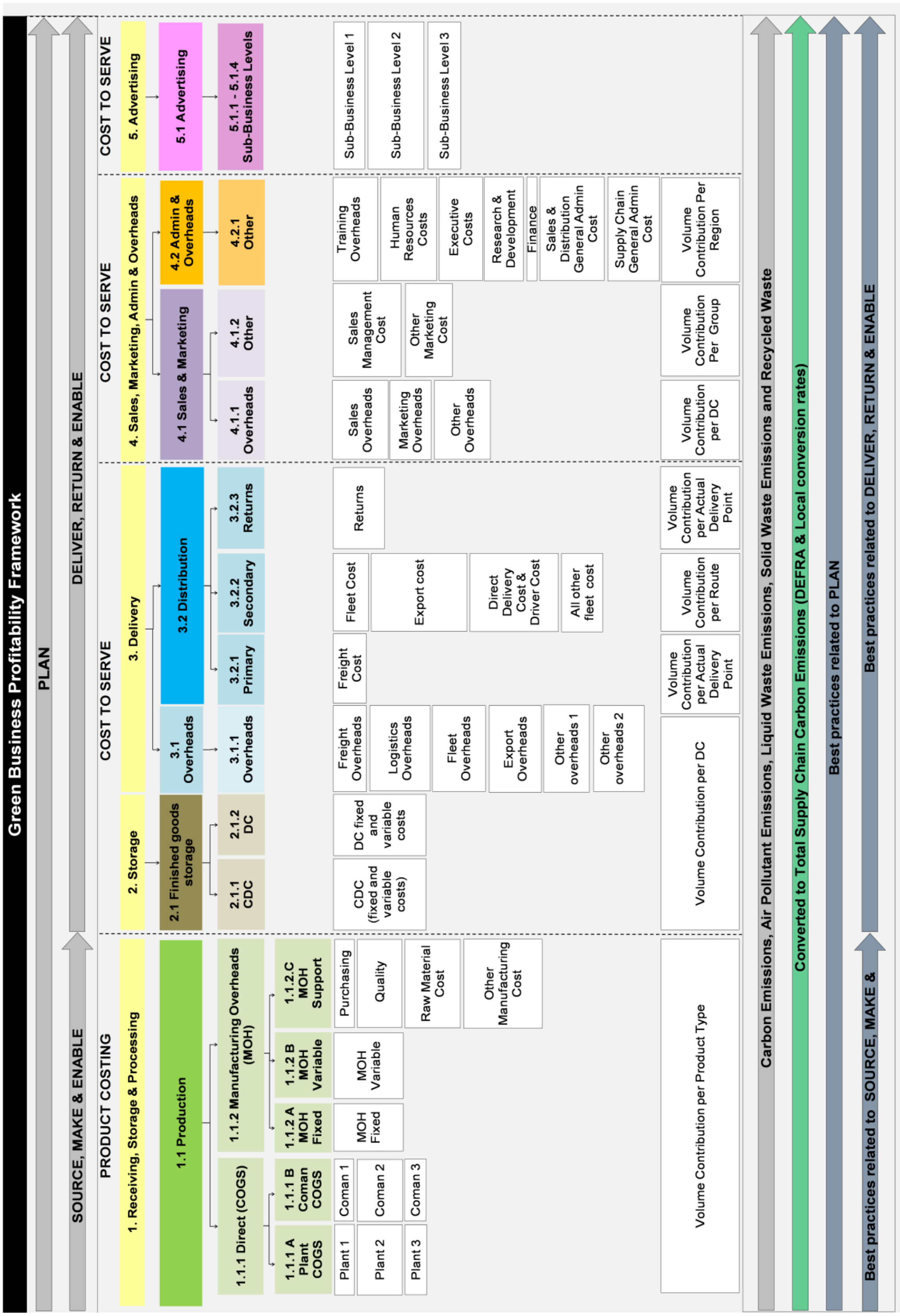


Figure 38: Developed Green Business Profitability Framework

3.2 Proposed Framework and Implementation

3.2.1. Proposed Framework

The Green Business Profitability Framework in Figure 38 uses a combination of SCOR, product costing, 'cost to serve', ABC costing, GreenSCOR, and BPM. The metrics defined by GreenSCOR will be used, and the measurements will be converted into carbon emissions using the emission factors sourced from DEFRA. Emissions factors that are not available from DEFRA will be obtained from emission factors developed by environmental agencies and from monitoring programmes, regulatory reports, waste shipping documents, and environmental permits. Due to the power generation differences between the United Kingdom – on which the DEFRA framework is based – and South Africa, a local electricity conversion to carbon emissions is used. The same rule applies to the natural gas conversion, for which a local conversion rate will be used. Finally, best practices are added to the framework.

According to DEFRA (n.d.), seven main greenhouse gases (GHGs) contribute to climate change. As defined by the Kyoto Protocol, these are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). To adhere to the Kyoto Protocol, all gases generated in all activities must be reported. DEFRA (n.d.) also states that carbon emissions (CO_2e) is the universally-accepted measurement of the global warming potential (GWP) of GHGs. The universally-accepted reporting unit for carbon emission is tonnes.

For each activity, predefined factors can be used to calculate the carbon emissions. DEFRA (n.d.) notes that the activities in the supply chain can be divided into three groups. The first group, 'direct emissions', includes all direct activities controlled by the business. The second group includes all emissions released into the atmosphere by the electricity that a company consumes. The third group includes all emissions as a result of business actions not related to a specific activity – for example, business travel, waste disposal, the purchase of raw material, etc. The United Nations (UN) (n.d.) defines the Kyoto Protocol as an agreement that is internationally known and that links to the UN Framework Convention on climate change. All countries are bound to the protocol, when they sign it, to reduce their emissions. The UN argues that developed countries have a greater responsibility to reduce their carbon emissions because they have been industrially active, and thus have had higher carbon emissions, for much longer.

DEFRA (n.d.) explains that in order to calculate carbon emissions, the data per activity must be converted into carbon emissions using a predefined carbon emissions table with standard conversions. For this study, DEFRA's (n.d.) carbon emission conversions will be used. For example, the kilogram carbon dioxide ($kgCO_2$) emissions of an activity using one kilowatt-hour (kWh) are 0.46213kg CO_2e per hour. See Appendix D for examples of the emission table from DEFRA.

3.2.2 Implementation Steps

The implementation plan derived from the supply chain council (SCC) (n.d.) and the US Department of Energy (n.d.) in Figure 39 will be used to implement and test the framework in various case studies. The first step focuses on determining the supply chain area on which to focus, and then performing an as-is assessment of the current cost and carbon emissions. The next step is to identify improvement opportunities that can result in less distance travelled and thus reduce carbon emissions and possibly cost. The business profitability and sustainability (in terms of carbon emissions) impacts of the improvement opportunities are then determined using the new framework. The framework will indicate the feasibility of implementing potential initiatives. It can also be used to monitor actual performance after implementation, and to determine how the actual results compare with the estimates.

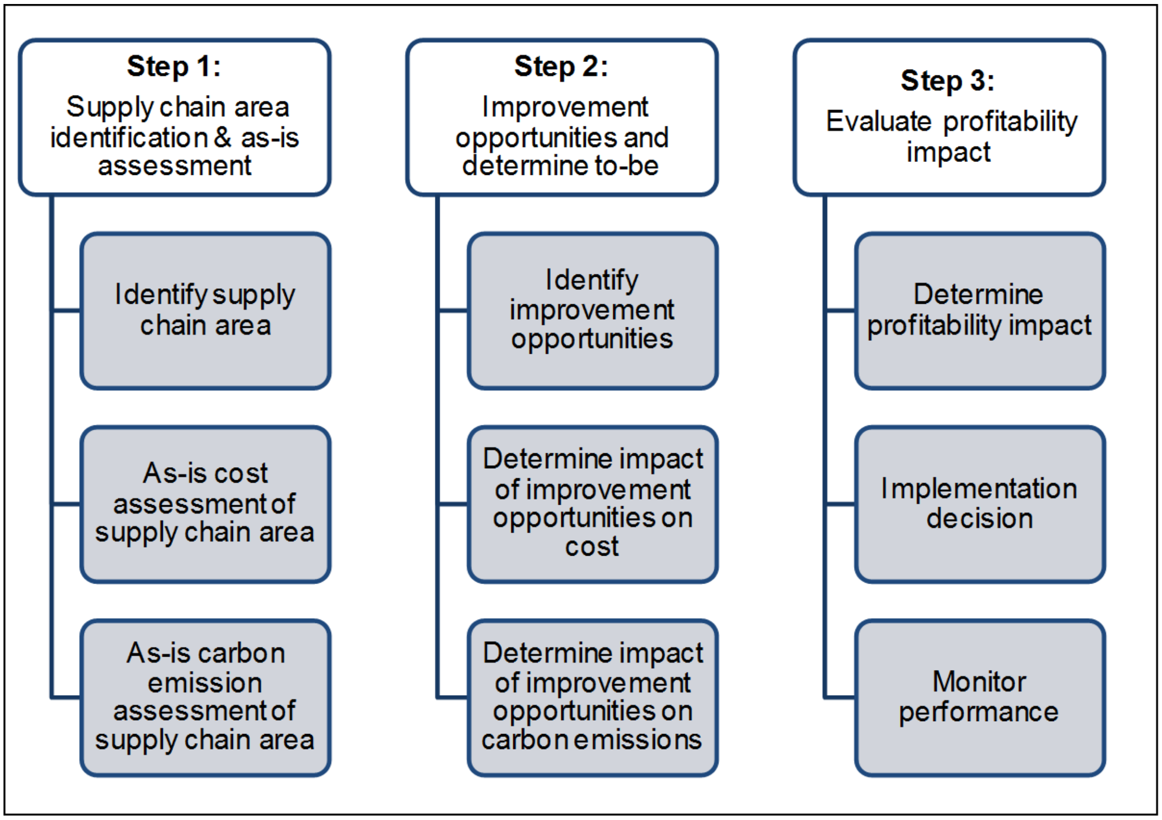


Figure 39: Green Business Profitability Framework implementation plan (Adapted from SCC n.d. and US Department of Energy n.d.)

3.3 Concluding Remarks

There is a gap in the availability of analytical tools to quantify GSCM (Porter and Van der Linde 1999; Srivastava 2007; Schaefer and Kosansky 2008; Marchal *et al.* 2011).The framework developed here will be a combination of previous framework ideas and methods together with part of the GreenSCOR model. The framework will be tested in a series of case studies at a single company. Various parts of the supply chain will be addressed in the investigation. The results will be tabled to compare outcomes and make recommendations. The case studies will cover a year of operation at the case study company in order to monitor the supply chain after green initiative implementation. This will be done according to the implementation framework described in section 3.2.1.

Chapter 4: Business Profitability Framework application

The Green Business Profitability Framework developed in Chapter 3 is applied to a South African company's supply chain to determine whether the framework can successfully quantify the environmental and business profitability impact. This chapter summarises the data gathering process, the analysis, the identification of key performance indicators, the testing of the framework in various case studies at the case study company, and the results of the case studies.

4.1 Data gathering process

According to the World Business Council of Sustainable Development (WBCSD) and the World Resources Institute (WRI) (n.d.), greenhouse gases (GHGs) are reported under three different scopes (or categories). The first scope includes all direct GHG emissions from resources owned and accounted for by the company. Activities such as the production of electricity, heat, and steam; physical and chemical processing; the transportation of products, material and waste; and emissions from leakages are all included under the first scope. The second scope includes all indirect emissions associated with the generation of electricity, steam, and heat. The third scope includes all emissions that result from actions by the reporting company – for example, employees' business travel, outsourced functions, waste emissions generated, and the production of imported materials that the company will use.

According to the WBCSD and WRI (n.d.), scopes one and two must be reported by all companies. Reporting on scope three GHG initiatives is optional. Figure 40 summarises the GHGs in the supply chain, and classifies the GHGs according to the different scopes (WBCSD and WRI n.d.).

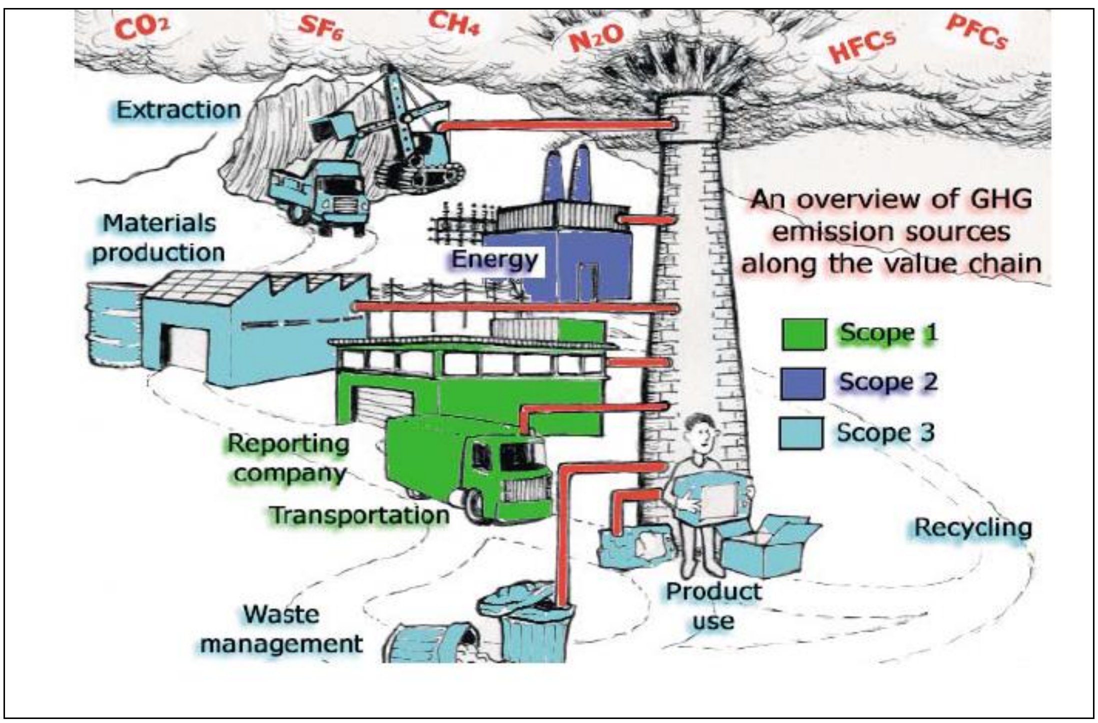


Figure 40: GHGs across the supply chain (Adapted from WBCSD and WRI 2001)

The different scopes identified by the WBCSD and WRI (n.d.) will be used to group the environmental initiatives and quantify their impact. This is because scopes one and two will be compulsory to report when the carbon tax law is implemented, whereas scope three will be optional. Scopes one and two will be the main focus of the GHG emissions reporting (Van Hille and Louw 2012).

To address the objectives of the research study – to apply the framework to a South African company's supply chain to determine whether the framework can successfully quantify the environmental and business profitability impact – the Green Business Profitability Framework will be applied to five case studies. These were identified from the overview of the GHG emissions provided in Figure 40, and will be used to determine the impact on the environment and on profitability by implementing initiatives aimed at reducing GHG emissions. And to ensure that different areas of the supply chain are addressed, level 1 processes of the supply chain operations reference model (SCOR) aided in the selection of the case studies.

To determine the environmental impact in the case studies, all the emissions will be converted into kilogram carbon emissions ($kgCO_2e$). This is a common and familiar method to quantify environmental impact, as described by the Department of Environment, Food and Rural Affairs (DEFRA) (n.d.). The time period considered in the case studies was one year, in order to include both peak and off-peak times. And, because financial performance is reported annually to the business and its shareholders, the full annual impact of the initiatives can be assessed.

The Green Business Profitability Framework presented in Chapter 3 will be used to establish the current financial and environmental baseline of the case study company. The environmental and profitability impact of the interventions investigated in the case studies, using the Green Business Profitability Framework, is compared against the current baseline for each of the five case studies described in detail below. The purpose of these case studies is to investigate whether the framework is suitable for determining the financial and environmental impacts of green initiatives in a business. The five case studies presented in this section are structured according to the supply chain operations reference model (SCOR) *plan, source, make, deliver*, and *return* supply chain building blocks (Supply Chain Council (SCC) n.d.). Refer to Table 4 below for a summary of the case studies.

Table 4: Details of case studies

Area	Case Study Description	Application
Plan	Optimisation of secondary transportation to reduce GHG by routing and scheduling	Modelling short-term network planning
Source	Sourcing of co-manufactured products	Modelling long-term strategic planning
Make	GHG reduction initiatives identified for manufacturing in Johannesburg, South Africa	Modelling impact of third party recommendations
Deliver	GHG reduction initiatives identified for the central distribution centre facility in Johannesburg, South Africa	Modelling the impact of current internal initiatives and new market trends
Return	Reduction of return loads of cartons, buybacks, and defective products from the DCs	Modelling the impact of operational change

The case studies address different applications of optimisation initiatives from short-term to longer-term strategic objectives. In the *plan* case study, the framework will be applied to determine whether it can be used to solve short-term network planning queries. The *source* case study will focus on long-term strategy development, while the *make* case study will incorporate recommendations from a third party consultant. The *deliver* case study will focus on modelling the impact of the current internal initiatives and market trends, while the *return* case study will determine the impact of operational changes in the case study company.

The current financial cost of the case study company for the past year will be analysed using the Green Business Profitability Framework. This will be to determine the current product costing, 'cost to serve', and profitability per business, sub-business, sales region, go to market (GTM), major customer group, central distribution centre (CDC), distribution centre (DC), item brand, route, and customer. Data sources will include the financial records of actual expenses and income of all the cost centres in the business, detailed sales per customer and product type, primary transportation cost and load detail, secondary transportation cost and load detail, CDC and DC expenses, co-manufacturing prices, raw material prices, and manufacturing schedule summaries per product type.

4.1.1. JDA Supply Chain Strategist

JDA software has three different focuses, and different software applies to each focus area. The focus areas are strategy, planning, and execution. For the strategic projects, Supply Chain Strategist (SCS) will apply; and for planning applications, Transport Optimiser will be used. Transport Manager (TMS) software will be applied for a focus on execution. The TMS software of JDA will be used in the *plan* case study, and SCS in the *source* case study for network modelling.

4.1.1.1. Transport Manager (TMS)

JDA's TMS software creates a transport management solution that synchronises the transportation processes. It balances the constraints and current costs with service goals, and takes the transportation lifecycle from order management to service delivery into account. Using this module can result in increased customer satisfaction, increased productivity, and a decrease in transportation costs (I2 Technologies 2016).

4.1.1.2 Supply Chain Strategist (SCS)

SCS is a multipurpose program that can be applied to various supply chain modelling scenarios. SCS is suitable for solving complex network flow and transportation problems (I2 Technologies 2016). As a supply chain modelling package, JDA SCS is a tool that uses optimisation methods whose main objective is to minimise cost while servicing the required demand by applying a multi-product and multi-period approach (Tynjala 2011). This package is used by the case study company, and works on the basis of eight modelling entity tables.

The eight modelling entity tables of SCS include *demand regions, service levels, facilities, processes, products, periods, transportation modes,* and *shipment sizes.* The entity tables are used to form multiple relationship tables – for example, what product is transported to which demand region in which period. The way the relationship tables are structured determines the conditions under which the model will search for an optimum. The relationship tables are:

- *Process at Facility* (which processes are active at which facility)
- *Process Component* (detail on the process)
- *Facility in Period* (which facility is open in which period)
- *Product in Period* (which product is active in which period)
- *Product at Facility* (which facility manufactures which product)
- *Product at Facility in Period* (which product is active at which facility in a specific period)
- *Process at Facility in Period* (which process is active at which facility in a specific period)
- *Demand Requirement* (what the demand requirement from the customers is)
- *Transportation Mode in Period* (which transportation mode is active in which period)
- *Transportation Mode Component* (detail on the transportation mode capacity, type, etc.)
- *Interfacility Link in Period* (whether any product is transported between facilities before being sold to the customer)
- *Service Link in Period* (transportation detail from the facility to customers)

The software offers a user interface (UI) from which Microsoft Excel and Microsoft Access can be used to import the data per table, starting with the eight entity tables and building the relationship links from there. Due to the complexity of the relationships, SCS is not very user-friendly for new modellers; but for experienced modellers it is a very useful tool. The optimisation results can be viewed in summary reports, tables, and a visualisation on a world map.

4.1.2 Case study detail

***Plan* case study:**

In accordance with other strategic projects at the business, the central Gauteng region, with four regional DCs, is the focus of the *plan* case study. Secondary transportation in the case study refers to the transport of products by company-owned vehicles to customers. Currently, secondary transportation is an in-house operation at the case study company, and the last network and route optimisation project was done before this study in 2010. This case study therefore determines whether it is worthwhile to optimise the current secondary transportation network by reducing the distance travelled to deliver to customers. The case study investigates the impact of reduced distances, for each of the four DCs, on the profitability and sustainability of the business.

To achieve this objective, the actual fixed and variable secondary transport costs for the last year, the geocodes of current customer locations, current delivery routes, and sales data for the past year were collected. Thereafter the optimal routing plan was determined using JDA's TMS (JDA n.d.). The software requires customer location data (geocodes), distribution centre locations (geocodes), volume per route per day, truck type per route, truck capacity per route, fixed cost per route, variable cost per route, the maximum kilometres travelled per day, and a demand forecast for the year. This optimal routing plan reallocates customers to DCs based on the optimal cost, maximum number of customers serviced per route, and total distance that must be travelled to the customer. Thereafter the current and optimised routing plans are compared to determine potential improvement initiatives. Finally, the impact of improvement initiatives on the business' profitability and sustainability (in terms of carbon emissions) is determined using the new Green Business Profitability Framework.

***Source* case study:**

For the *Source* case study, the co-manufacturing product network was investigated to develop a five-year strategic roadmap using JDA SCS. It considered current growth and growth targets to determine where the next co-manufacturing facility should optimally be located, in order to reduce the distance travelled to deliver products to the CDCs for distribution to customers. The aim was to reduce carbon emissions and costs. Data gathering consists of actual costs for the past year for manufacturing, warehousing and distribution, strategic plans for potential co-manufacturing location options, forecasted growth, and transportation rates of third party logistics providers to transport products from the new locations. The aim of the *source* case study is to use the Green Business Profitability Framework to aid with strategic planning. Sourcing products against a reduced cost will decrease the cost of goods. The case study also focuses on determining whether the Green Business Profitability Framework is beneficial to use in quantifying the financial and environmental impact.

***Make* case study:**

The *Make* case study focuses on the Johannesburg manufacturing facility. It considers various areas of the production line, and includes modelling the business profitability and environmental impact of certain initiatives recommended by McComb (2013). McComb (2013) conducted a study at the case study company, focusing on small and medium-sized enterprises (SMEs), on behalf of the Council for Scientific and Industrial Research

(CSIR). The case study company will use the findings of the report before they consider changing their current operation. The aim of this case study is to use kilowatt-hour (kWh) and liquefied petroleum gas (LPG) savings (suggested by a third party) and to convert this, using the Green Business Profitability Framework, into tangible environmental and profitability impact before making any changes.

McComb (2013) estimated the potential kWh and cost reductions or increases of certain initiatives. The environmental and profitability impact indicates which initiatives have the biggest impact and are worthwhile implementing. McComb (2013) also indicates which initiatives might reduce the profitability of the product significantly, and thus the company needs to consider increasing the price of the product, reducing other costs to absorb impact, or being able to handle the profitability reduction for environmental gain. Recommended initiatives include electricity and LPG reduction approaches.

Data is gathered from McComb (2013), and the current as-is plant running cost for 2015 is used to calculate the cost and carbon emissions savings.

***Deliver* case study:**

The *Deliver* case study includes modelling the current impact of market trends and Green Supply Chain Management (GSCM) ideas in the CDC warehouse. The CDC in Johannesburg is regarded as the main one in the country, and is used for the *deliver* case study. Data gathering includes searching for the latest market trends in green warehouses and related activities by using case studies from companies in the Fast Moving Consumer Goods (FMCG) industry as a base. Other data sources include the cost of running the warehouse for the previous year, electricity charges, and the cost of fluorescent lighting.

***Return* case study:**

The *Return* case study focuses on modelling suggested operational changes and what financial and environmental impact can be expected when implementing these changes. The *return* case study focuses on the reduction of return loads and disposal of stale products at the different central DCs, instead of moving all the stale products back to the plant in Johannesburg. The data gathered includes the return cost, fuel used, and kilometres travelled.

In the next section, the Green Business Profitability Framework is applied to the case studies to determine the suitability of the framework for quantifying the environmental and profitability impact.

4.2 Framework application

4.2.1 Baseline for case studies

Using the implementation steps in Figure 39, the Green Business Profitability Framework is firstly populated with the costs of the previous year. This serves as the baseline for the case study applications. Note that a confidentiality agreement has been entered into with the case study company; therefore any financial information, monetary amounts, or customer information may not be published. Values similar to the actual values will thus be used as substitutes in the case studies. Figure 41 illustrates the baseline framework with the current costing reflected as a percentage per process.

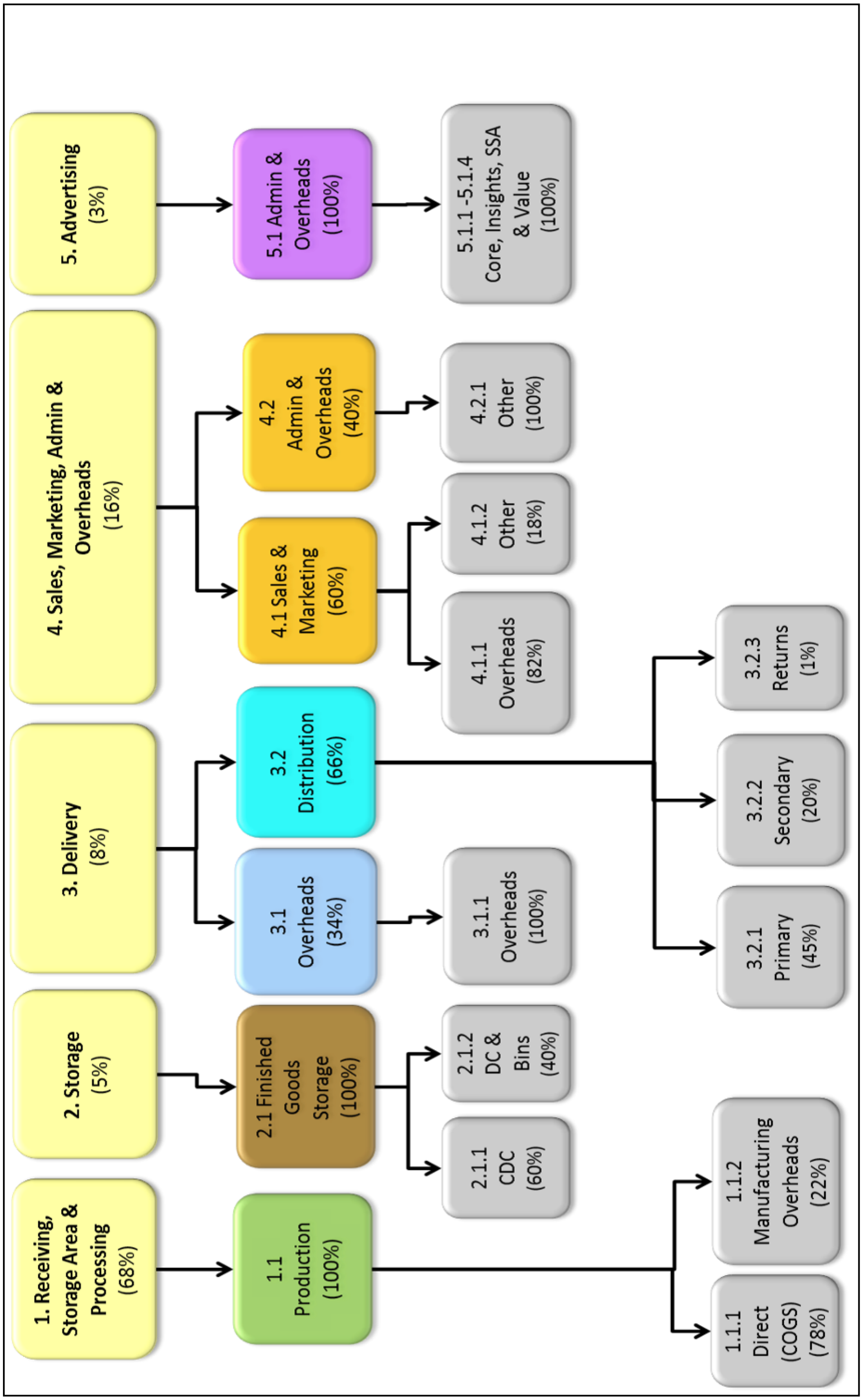


Figure 41: Baseline spend per cent per process

Production and raw material costs make up 68 per cent of the total annual expenses of the case study company. The remaining 32 per cent of the total annual expenses (represented in the yellow marked blocks in Figure 41) is divided between storage (5 per cent), delivery (8 per cent), sales, marketing, administration, and overheads (16 per cent), and advertising (3 per cent). The second and third layer represents the lower-level data of the process blocks. Of the production cost, 78 per cent is from direct manufacturing costs (cost of goods sold (COGS)), which are the costs directly related to manufacturing, and 22 per cent from manufacturing overhead (MOH). The CDC cost makes up 60 per cent of the finished goods storage cost, and the DC cost is 40 per cent. The overhead cost of the deliveries contributes 34 per cent, while the primary cost contributes 45 per cent, secondary cost 20 per cent, and the return cost 1 per cent. Sales and marketing activities contribute 60 per cent, and administration and other overheads make up 40 per cent of the total sales, marketing, administration, and overheads spend. The percentage contribution of the cost indicates the impact that the cost might have on the total cost, and thus the impact on profitability of a business, when this cost increases or decreases.

The Green Business Profitability Framework is implemented in Microsoft Excel, and enables the updating of sales per customer and product type, as well as the actual financial expenses every month. There are nine Microsoft Excel costing models that feed into each other using Visual Basic for Applications (VBA script) macros. The output from the costing models is a single Microsoft Excel spreadsheet that summarises the cost impact per area identified in Figure 36. An extract from the results sheet of the baseline calculations can be found in Appendix E.

The novel business profitability calculation approach used by the Green Business Profitability Framework will enable a business to determine how customers and products contribute to profitability on an individual level. Once these splits are made, various gross profits (GPs) are calculated to determine the breakeven point for the various products and customers. Different GP levels can be calculated, depending on the industry and management requirements. Sales and marketing refer to the sales and marketing expenses in terms of salaries and other overhead costs, whereas the advertising and marketing refer more to the physical marketing material used for promotions and special offers, therefore the duplication in the GP4 and GP6 of marketing cost. Tables 5 and 6 summarise the gross profit calculations and levels that can be used in the framework. For example, GP1 will be revenue less the COGS, and GP2 will be GP1 less storage cost.

Table 5: Gross profit levels

Level	Calculation
Net Revenue	Gross Revenue - discount & allowances
GP1	Net Revenue - Cost of goods sold (COGS)
GP2	GP1 - Storage Cost
GP3	GP2 - Delivery Cost
GP4	GP3 - Sales & Marketing
GP5	GP4 - Admin & Overhead Cost
GP6	GP5 - Advertising & Marketing Cost

Table 6: Gross profit calculations

Revenue
Less Cost of Goods Sold (COGS)
Gross Profit 1 (GP1)
Less Storage
Gross Profit 2 (GP2)
Less Delivery
Gross Profit 3 (GP3)
Less Sales & Marketing
Gross Profit 4 (GP4)
Less Admin & Overheads
Gross Profit 5 (GP5) (Net Profit Before Tax)

Linking back to Figure 36 in Chapter 3, the business profitability can be calculated for the following levels:

- L1 – Business level (split between local and export businesses)
- L2 – Sub-Business level (split between core products and products)
- L3 – Sales region level (split between regions)
- L4 – GTM category level (split between different GTM categories)
- L5 – Major group level (split between major customer groups)
- L6 – CDC and DC level (split between DCs)
- L7 – Item brand level (split between item brands)
- L8 – Item brand level with a co-manufactured category (split between item brands, with unique identifier for co-manufactured products)
- L9 – Route level (split between routes)

The summary costing page in Microsoft Excel is an input document into the Green Business Profitability Framework that calculates the profitability per customer, product type, route, DC, etc. Figure 42 illustrates the highest level of the profitability calculation of the framework.

In Figure 42 the profitability per business level is calculated, resulting in a total profitability of 8 per cent (GP6 per cent) for business level 1 (local and export products). This figure displays the gross profit level 6, which measures the final productivity after all costs, fixed and variable, have been deducted. In level 1 the delivery costs use 6 per cent of the profit, and storage costs use 4 per cent. Business level 2 has a total GP6 profitability of 5 per cent.

In Figure 43 the second calculation is the unit rate (R per kg) profitability, which is R3.44 for business level one and R1.92 for business level 2. This implies that, for every kilogram sold for business level 1 (local and export products), the company will make R3.44 profit.

The third measurement is the unit rate as a percentage of gross sales, which indicates how much of the gross profit the specific process in the supply chain is consuming. This can be used to track improvement initiatives and understand their true impact.

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4	GP4%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921	563 684 708	26%	213 844 382	349 840 326	16%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	19%	8 527 141	38 058 358	15%
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25%**	**222 371 522**	**387 898 685**	**16%**

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	349 840 326	16%	129 317 122	220 523 204	10%	49 524 273	170 998 932	8%	49 664 510
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	38 058 358	15%	16 162 569	21 895 789	9%	9 987 184	11 908 605	5%	6 204 324
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**387 898 685**	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**

Figure 42 Business Level Data output – Green Business Profitability Framework

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
Business Level 1	52.57	8.52	44.05	27.72	16.34	2.00	14.33	2.98	11.35	4.31	7.04	2.60	4.44	1.00	3.44
Business Level 2	56.73	17.03	39.70	26.16	13.54	1.02	12.52	5.01	7.51	1.37	6.13	2.61	3.53	1.61	1.92

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale (%)	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
Business Level 1	53%	31%	4%	27%	6%	22%	8%	13%	5%	8.4%	2%	6.5%
Business Level 2	46%	24%	2%	22%	9%	13%	2%	11%	5%	6.2%	3%	3.4%

Figure 43: Business level data output – Unit rate and unit rate per cent

Figure 44 illustrates the graph that the Microsoft Excel spreadsheet generates. This is a cumulative graph that indicates that business unit level 1 contributes R170 998 932 of profit after the deduction of all costs, and business level 2 contributes an additional R11 908 605. The total of the two business levels indicates the total profit of the business (GP6) of R182 907 537.

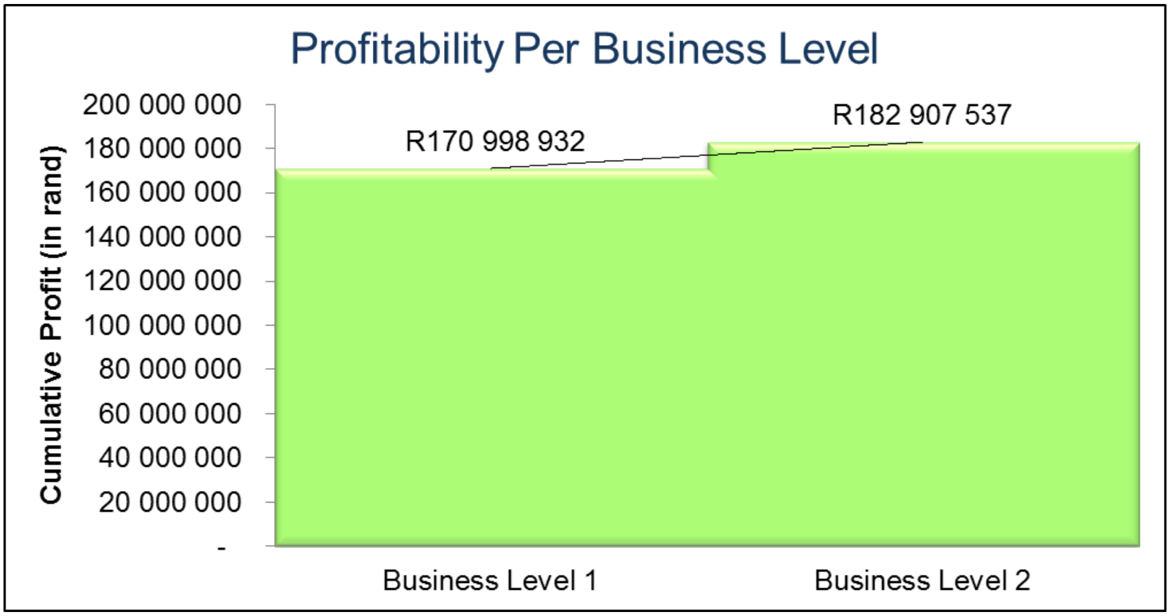


Figure 44: Green Business Profitability Framework – Profitability per business level

Figure 45 illustrates the profitability per item brand, and indicates which items are the main profit contributors. Item brands 12 to 17 make a minimum profit, and the input costs are almost the same as the profit. For these item brands, alternative GTM ideas must be investigated; increasing any costs might cause a reduction in the business' profitability. Item brands 18 to 26 must be investigated to understand why the costs exceed profit for these items. The rest of the item brands (marked in green) contribute significantly to profitability. The full Green Business Profitability Framework with all its levels can be viewed in Appendix E.

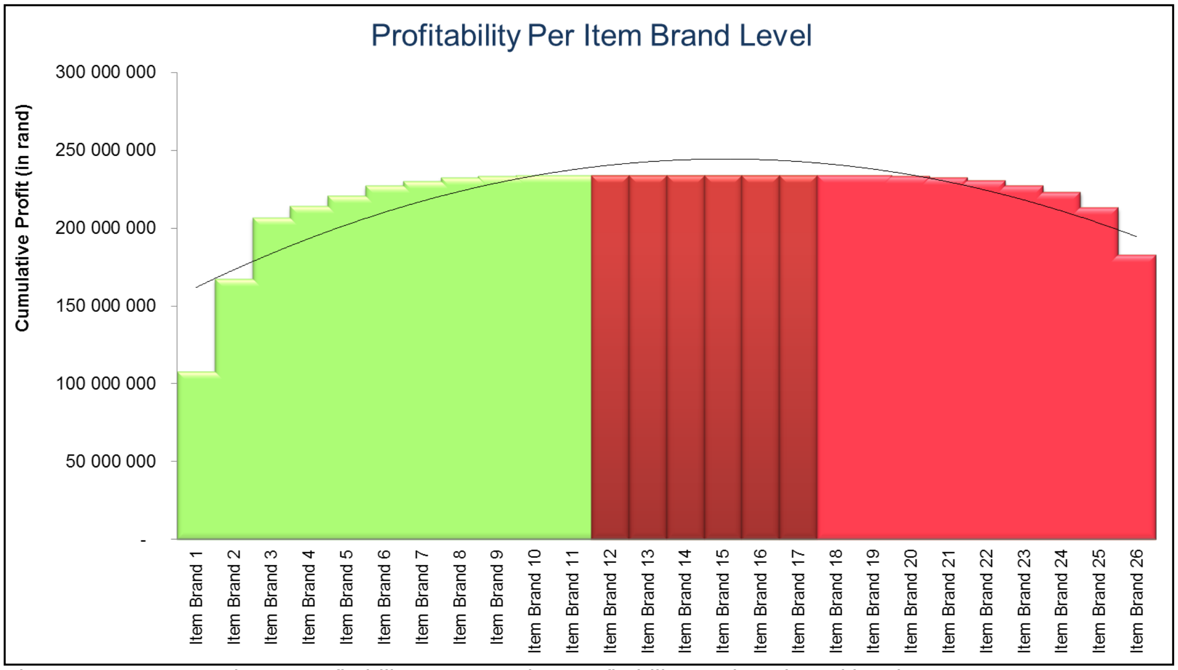


Figure 45: Green Business Profitability Framework – Profitability per item brand level

Additional functionality provided by the framework offers profit and loss analyses. Figure 46 illustrates the breakdown of profit and loss for the sub-business level (L2). As mentioned earlier, the production cost centre is the biggest contributor to the cost of the product, and requires a large number of resources to run the processes. The cost of goods includes all the raw material procurement and the manufacturing costs of the product before storage.

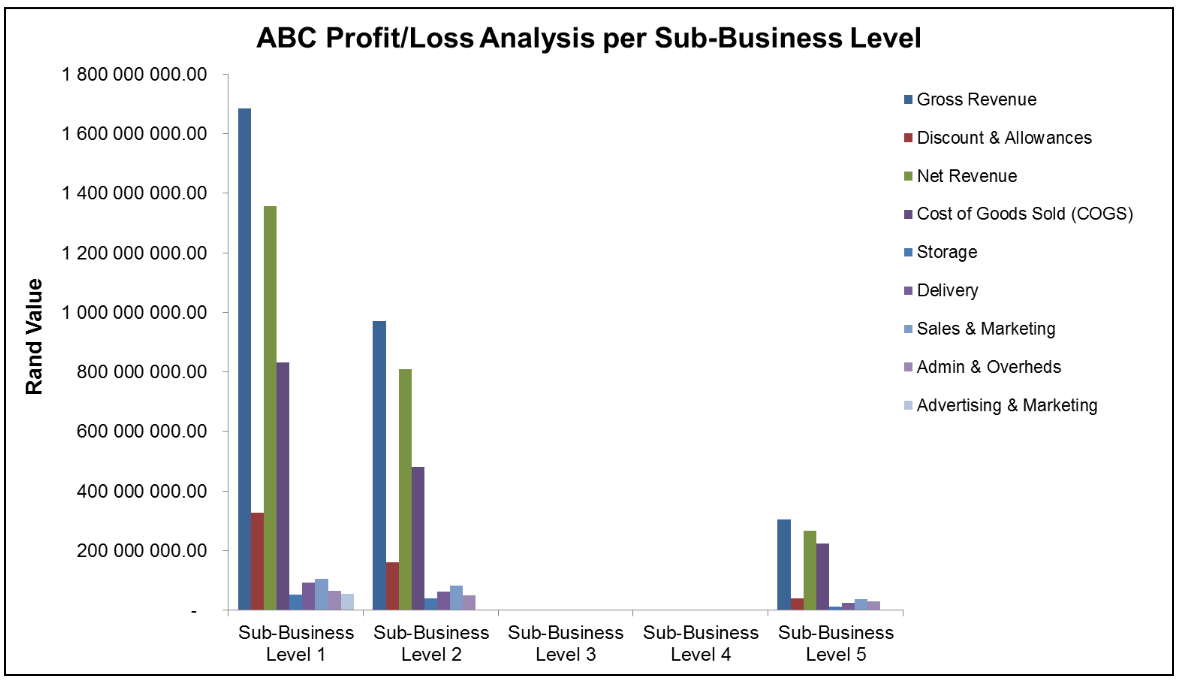


Figure 46: Green Business Profitability Framework– Profitability per sub-business level

Another functionality of the framework is the ability to summarise the net profit against the 'cost to serve' cost of the product per export country or level, which can be applied at any of the levels of the framework (refer to Figure 47). The export countries in this case study are grouped into different sectors to understand which supply chains to protect, grow, repair, or modify, due to low or no profit margins. The boundaries were determined by using a benchmark for net profit of R36 per kg, and a 'cost to serve' cost of R36 per kg. A 'cost to serve' cost of R36 per kg is therefore the breakeven cost point for delivery to African countries, for a profit that is high enough to make it worthwhile, while taking all the risks into account.

A net profit below R36 per kg will fall into either the 'grow' or the 'alternative' category. The 'grow' category indicates that this export opportunity needs to grow in future, and 'alternative' indicates that there must be an alternative to the current GTM method and sales to that specific country to reduce the costs. The customers who have a 'cost to serve' lower than R36 per kg and a profitability of more than R36 per kg are those who need to be protected, due to their profitability. The customers who will need urgent attention will be those with a high 'cost to serve' and profitability in the 'fix' category. Export countries 5 and 6 only marginally cover their cost, and the 'cost to serve' of these countries consumes most of the profit. Here another GTM solution should be investigated.

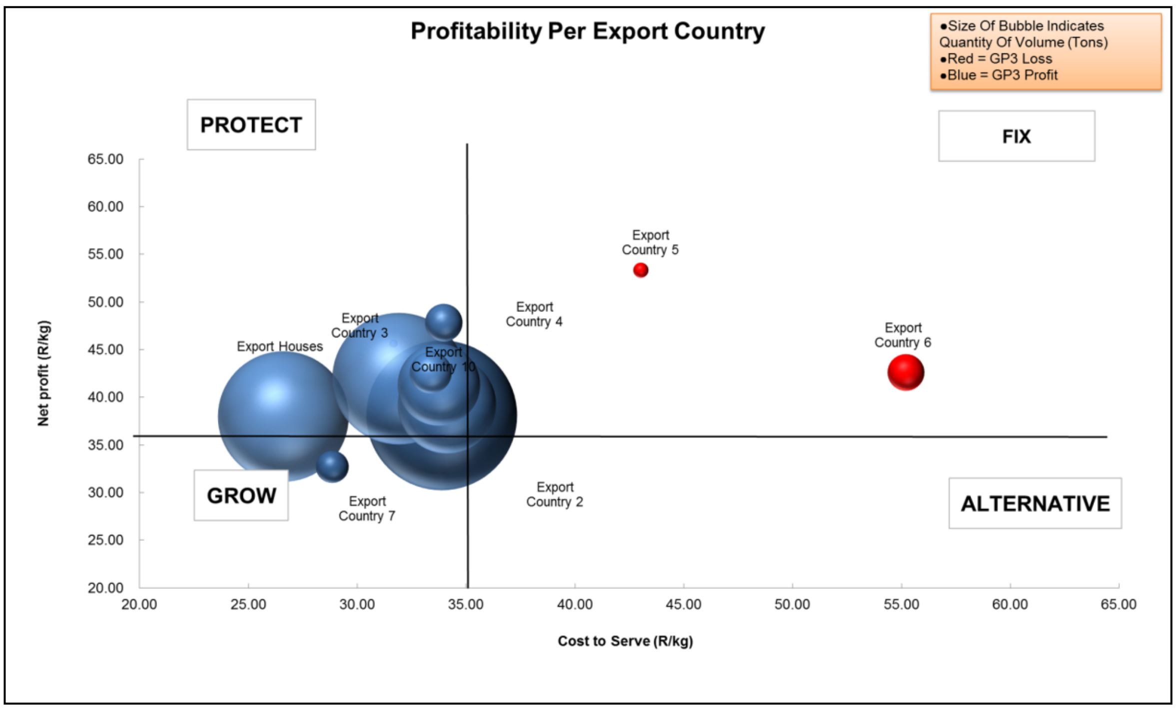


Figure 47: Green Business Profitability Framework – Profitability per export country

Current costs are referred to as 'baseline costing', and will be used as the base to compare any changes brought by implementing green supply chain initiatives in the case study company. The Green Business Profitability Framework can enable a business to measure the impact of GSCM on the business' investment in profitability.

In Sections 4.2.2 to 4.2.6 below, the developed Green Business Profitability Framework is applied to five case studies at a South African FMCG. As previously mentioned, the purpose of these case studies is to investigate whether the framework is suitable for determining the financial and environmental impacts of green initiatives in a business.

4.2.2 Case Study: *Plan*

This case study determines whether it is worthwhile to optimise the current secondary transportation network by reducing the distance travelled to deliver to customers. It also investigates the impact of reduced distances on the profitability and sustainability of the business, for each of the four DCs.

To achieve this, as mentioned, the actual fixed and variable secondary transport costs for the previous year, geocodes of current customer locations, current delivery routes, and sales data for the previous year were collected. Thereafter, the optimal routing plan was determined using JDA's TMS (JDA n.d.). Using this module resulted in increased customer satisfaction, increased productivity, and lower transportation costs. This optimal routing plan reallocates customers to DCs based on their location. The current and optimised routing plans are then compared to determine potential improvement initiatives. Finally, the impact of improvement initiatives on the profitability and sustainability (in terms of carbon emissions) of a business is determined, using the new Green Business Profitability Framework.

The current customer groupings per DC are not ideal, and part of the exercise is to re-allocate customers to a DC nearer to them. The current situation per DC is summarised by the number of trucks operating from the facility, the number of deliveries, the number of kilometres driven per week, and the average number of deliveries per vehicle. Figure 48 shows the current customer groupings per DC for the four Gauteng central DCs included in the analysis. Table 7 summarises the detail for DC1, with a base fleet of 31 trucks, 1331 deliveries per week, and an average travel distance of 14 890 km per week.

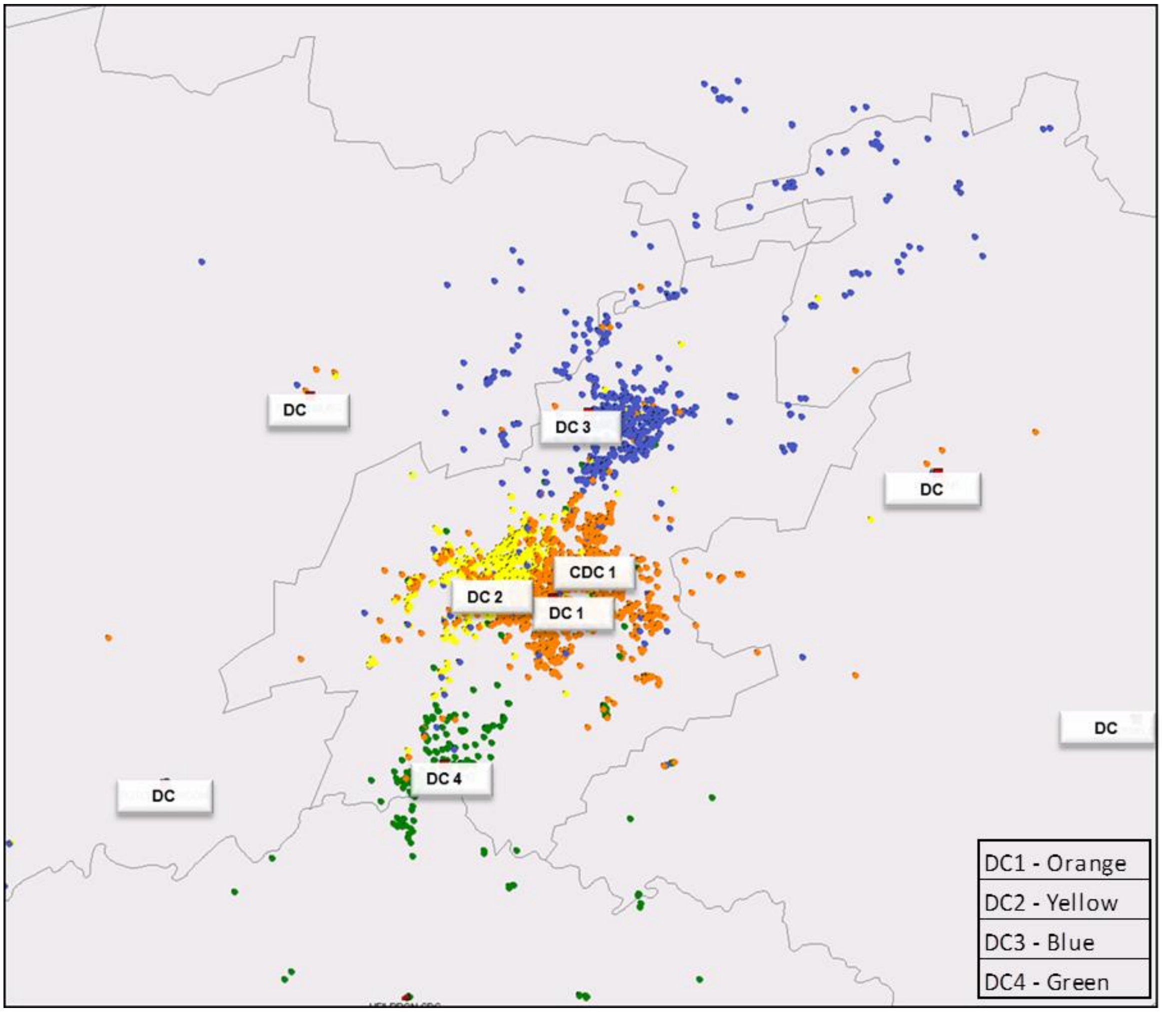


Figure 48: Customer grouping for DCs 1 to 4

Table 7: Current DC 1 detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	274	25	6 580	31	11	2 767	111
Tuesday	282	26	8 613	31	10.8	2 812	108
Wednesday	250	27	8 116	31	9.3	2 285	85
Thursday	298	26	8 158	31	11.5	3 272	126
Friday	227	24	7 835	31	9.5	3 753	156
	1 331	**128**			**10.40**	**14 890**	**116.33**

The second DC has a base fleet of 20 vehicles, servicing 626 drop points and driving 5 838 km per week. The third DC travels a greater distance to customers with a total of 18 356 km per week. The DC operates 25 vehicles and serves 1 078 customers. The fourth DC only has 339 customers, and services them with a base fleet of nine vehicles. The weekly kilometres add up to 6 791 kilometres. (Refer to Appendix F for additional information.)

Optimising the current secondary distribution of the central Gauteng region impacts the number of drops per DC, the number of vehicles required, and the number of kilometres driven. Table 8 illustrate the suggested DC1 delivery detail. In Table 9 the optimisation detail per DC is quantified. By optimising the routes, the number of drops reduces by 87, the base fleet reduces by three vehicles per week, and the number of kilometres travelled reduces by 5 377 km (36 per cent).

Table 8: DC 1 optimisation detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	265	23	6 190	28	11.5	1 670	72.6
Tuesday	274	26	8 726	28	10.5	1 947	74.9
Wednesday	220	18	8 646	28	12.2	1 708	94.9
Thursday	284	28	7 252	28	10.1	1 941	69.3
Friday	201	21	5 164	28	9.6	2 247	107.0
	1 244	**116**			**10.72**	**9 513**	**82.01**

Table 9: DC 1 impact detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	9	2	390	3	-1	1 098	38
Tuesday	8	-	-113	3	0	865	33
Wednesday	30	9	-531	3	-3	577	-10
Thursday	14	-2	906	3	1	1 332	57
Friday	26	3	2 672	3	-0	1 506	49
	87	**12**			**-1.80**	**5 377**	**167**

Appendix F gives the calculation details for DCs 2, 3, and 4. For DC 2 the number of drops increases by 72, while the base fleet reduces by 10 vehicles and the kilometres are reduced by 458 km (8 per cent). For DC 3 the number of drops remains constant, while the base fleet increases by six vehicles and the kilometres travelled are reduced by 2 367 km (13 per cent). For DC 4 the number of drops increases by 19, and the base fleet increases by one vehicle. The kilometres travelled are reduced by 1 239 km (18 per cent).

In summary, the changes in the four inland central DCs brought by the network optimisation project reflect an average increase of four drops, an increase in the average drops per vehicle by three, an average reduction of four in the number of vehicles, and an average reduction of 8 941 km travelled – 19 per cent of the total kilometres travelled.

4.2.2.1 Green Business Profitability Framework - *Plan*

The green supply chain operations reference model (GreenSCOR) model links best practices to the *plan* processes, as illustrated in Figure 49. The suggested best practices applicable to this case study *(minimise vehicle fuel usage, maximise loads, and minimise returns)* link to the process *P4 plan deliver (carbon emissions).* These level 3 best practices then flow into the level 2 process *plan carbon emissions* and into *total supply chain carbon footprint* (level 1). This was used as a guideline in the case study to review the number of kilometres travelled to customers that would reduce carbon emissions. The GreenSCOR model identified the best practice that can be used by the Green Business Profitability Framework. The impact of optimising the Gauteng central secondary transport routing leads to a reduction of 19 per cent in fuel costs and kilometres, and in the variable costs of the vehicles. There is also a reduction in the fixed costs of vehicles by removing four trucks, where the fixed costs can include fleet, overheads, equipment, rental, and insurance. Variable costs are those that vary with the number of kilometres driven, and can include fuel, oil, tyres, repair cost, maintenance, e-tolls, depreciation, traffic fines and driver salaries. The fixed and variable costs are assigned to a product type and customer, based on the percentage of the truck capacity and sales volume of the route that those specific customers and products will consume. The cost allocation is based on a percentage.

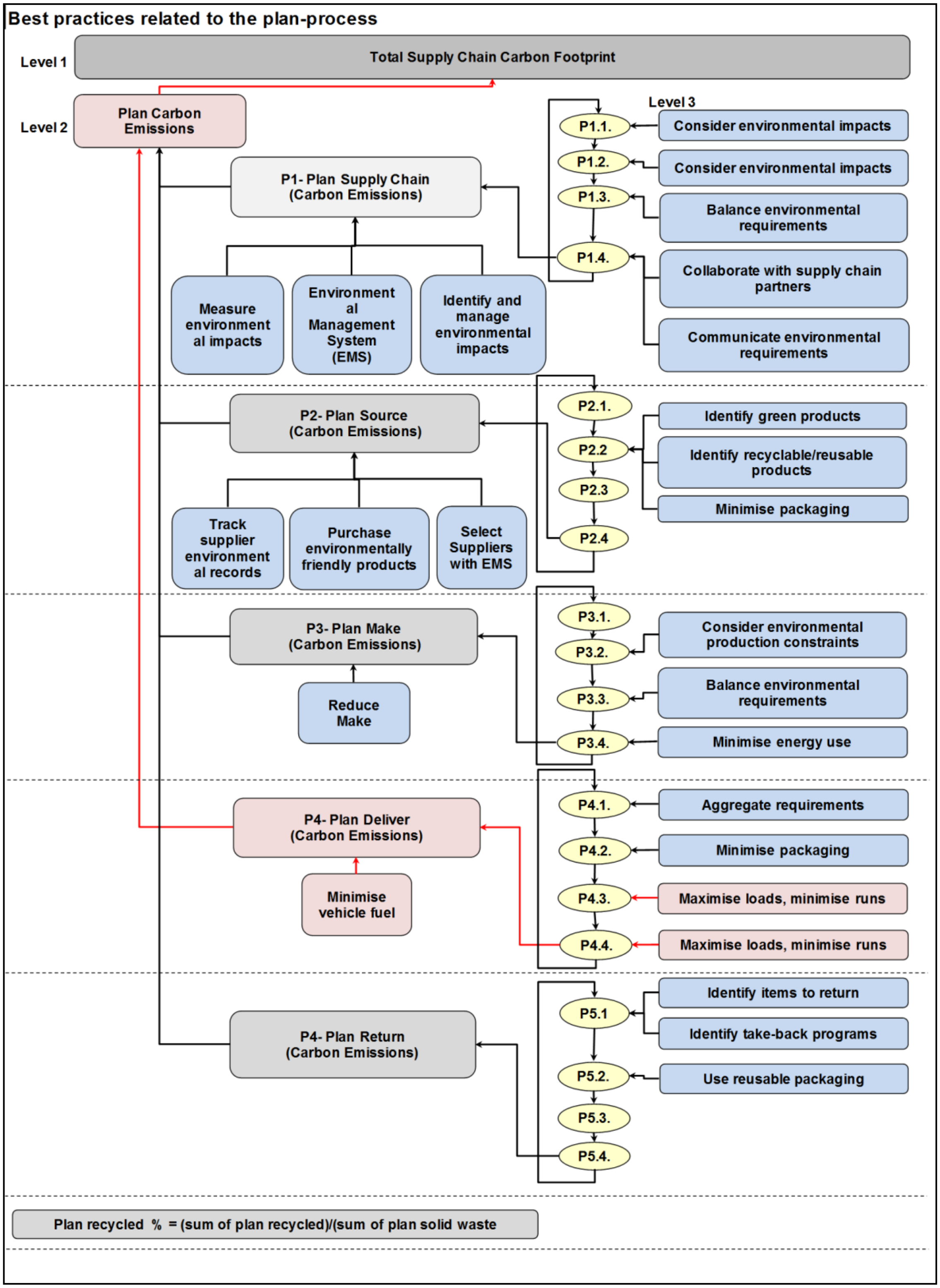


Figure 49: Best practices related to the *plan* process of the SCOR model (Adapted from SCC n.d. and Van Zyl 2010)

The total variable cost is reduced by R628 448 and the fixed cost by R454 278. The total cost reduction for the discussed changes is R1 082 726 per annum. The annual savings of the four central Gauteng DCs are R709 550 for DC1, R294 272 for DC2, R14 434 for DC3, and R64 468 for DC4.

The change is experienced at the GP3 level, since reducing the secondary distribution cost is part of the delivery cost. Figures 50 and 51 show the difference in the profitability per business level, while Figures 52 and 53 display the original routing against the profitability impact per CDC and DC of the optimised routing. The darker green highlighted DCs are those that are impacted in the planning scenario.

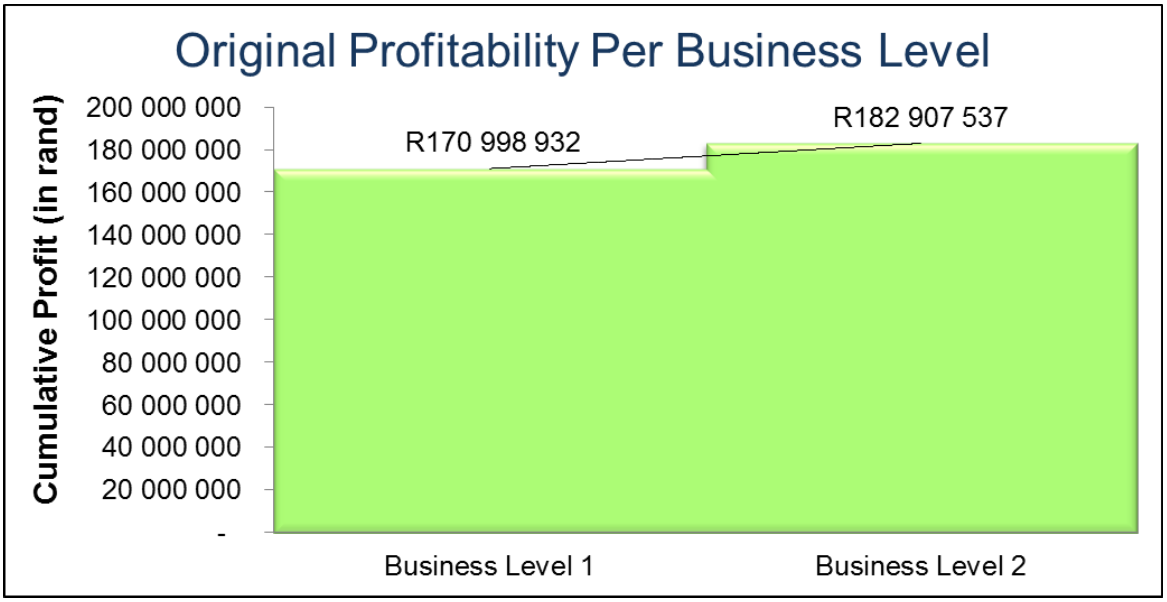


Figure 50: *Plan* case study: As-is GP6 values per business level

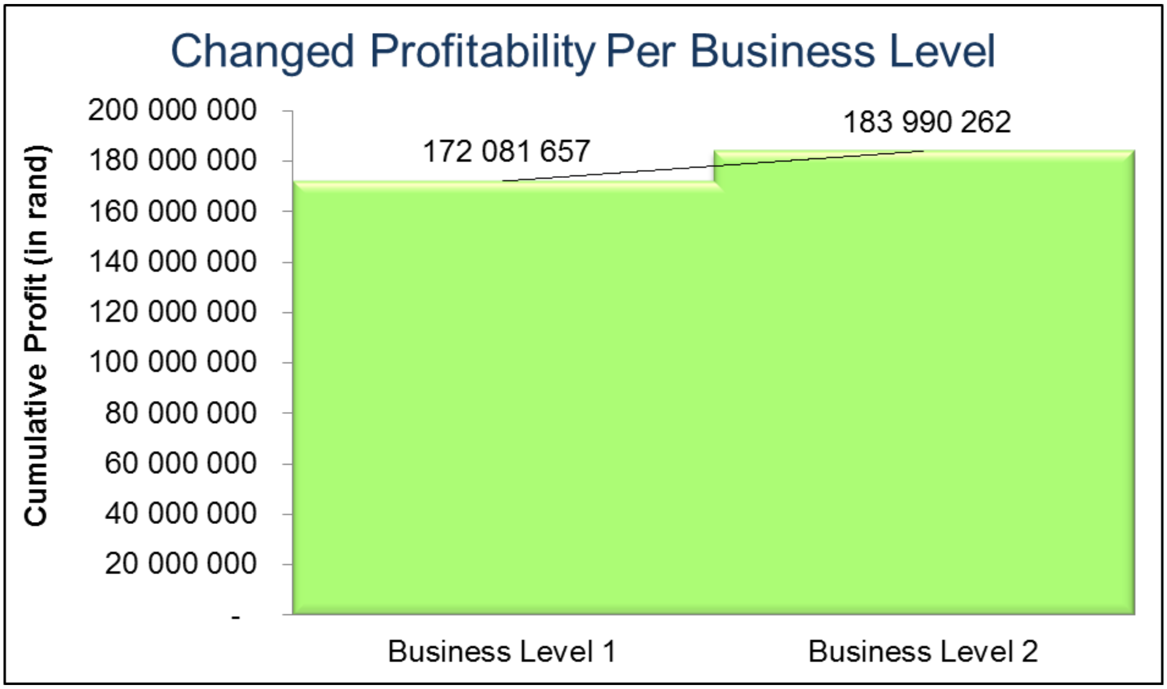


Figure 51: *Plan* case study: Impact of GP6 detail per business level

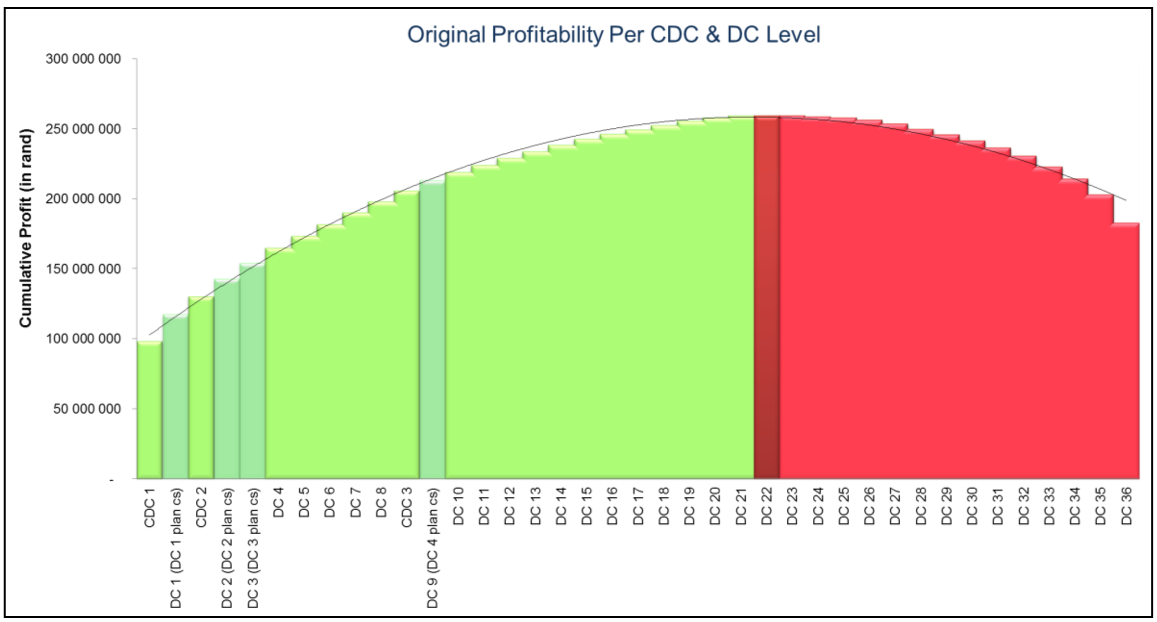


Figure 52: *Plan* case study: As-is GP6 detail per DC

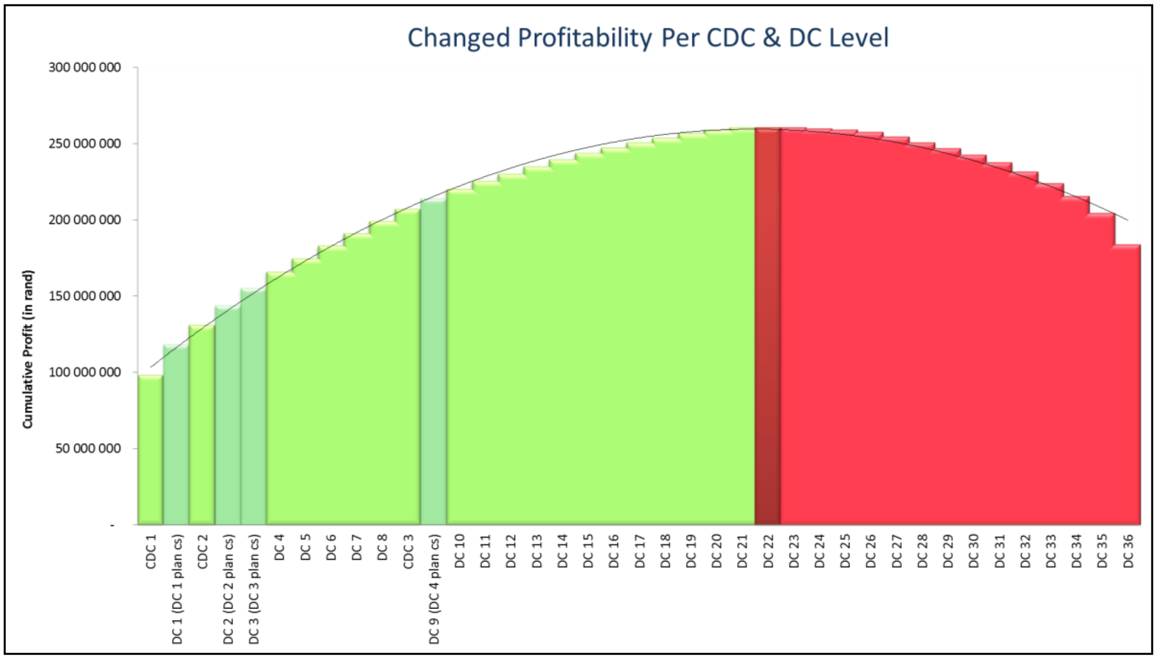


Figure 53: *Plan* case study: Impact GP6 detail per DC

The detailed application of the Green Business Profitability Framework is shown in Figures 54 and 55. The framework shows that the GP3 impact is 0.04 per cent, the GP6 impact is 0.04 per cent, and the total saving is R1 million. The highlighted columns in the figures indicate where the calculation impacts the framework.

As-Is Cost:

**Largest to Smallest GP6*

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921	563 684 708	25.8%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.9%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25.1%**

Plan Scenario Modelling:

With vehicle changes, fixed cost changes etc.:

**Largest to Smallest GP6*

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	146 981 196	564 767 434	25.8%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.9%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**178 084 142**	**611 352 933**	**25.1%**

Difference in GP3	**0.04%**

Figure 54: *Plan* case study – GP3 impact of 0.04 per cent

As-Is Cost:

*Largest to Smallest GP6

Business Level	Sales & Marketing	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	213 844 382	349 840 326	16%	129 317 122	220 523 204	10%	49 524 273	170 998 932	7.8%	49 664 510	27 016 594
Business Level 2	8 527 141	38 058 358	15%	16 162 569	21 895 789	9%	9 987 184	11 908 605	4.8%	6 204 324	3 396 348
	222 371 522	**387 898 685**	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**7.5%**	**55 868 835**	**30 412 942**

Plan Scenario

With vehicle

*Largest to Smallest GP6

Business Level	Sales & Marketing	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	213 844 382	350 923 052	16%	129 317 122	221 605 930	10%	49 524 273	172 081 657	7.9%	49 664 510	27 016 594
Business Level 2	8 527 141	38 058 358	15%	16 162 569	21 895 789	9%	9 987 184	11 908 605	4.8%	6 204 324	3 396 348
	222 371 522	**388 981 411**	**16%**	**145 479 691**	**243 501 719**	**10%**	**59 511 457**	**183 990 262**	**7.6%**	**55 868 835**	**30 412 942**

Difference in GP6	**0.04%**
Total saving	**1 082 726**

Figure 55: *Plan* case study – GP6 impact of 0.04 per cent and total saving of R1 million

In order for a business to understand the total business profitability impact, the carbon emissions must be related to a cost impact, and from there to a profitability impact, to understand the total supply chain impact of the change. The kilometres travelled are directly related to the fuel used – the main driver of carbon emissions. The total $kgCO_2e$ per DC is calculated and summarised into an overall impact by using the DEFRA (n.d.) carbon emission conversions for distribution shown in Figure 56. For the calculation, the average vehicles category (up to 3.5 tonnes) is used, which covers all the secondary fleet sizes. One kilometre equates to $0.24999kgCO_2e$. The kilometres are then multiplied by the carbon emission factor to calculate the total carbon emissions, as seen in Table 10.

			Diesel			
Activity	**Type**	**Unit**	**kg CO_2e**	**kg CO_2**	**kg CH_4**	**kg N_2O**
Vans	Class I (up to 1.305 tonnes)	tonne.km	0.61214	0.607749	0.000215	0.004175
		km	0.144477	0.143441	0.000051	0.000985
		miles	0.232514	0.230846	0.000082	0.001586
	Class II (1.305 to 1.74 tonnes)	tonne.km	0.633423	0.628961	0.000141	0.004321
		km	0.228331	0.226723	0.000051	0.001558
		miles	0.367463	0.364875	0.000082	0.002507
	Class III (1.74 to 3.5 tonnes)	tonne.km	0.502728	0.499203	0.000095	0.00343
		km	0.267749	0.265872	0.000051	0.001827
		miles	0.4309	0.427879	0.000082	0.00294
	Average (up to 3.5 tonnes)	tonne.km	0.529972	0.526249	0.000108	0.003615
		km	**0.24999**	0.248233	0.000051	0.001705
		miles	0.402319	0.399493	0.000082	0.002745

Figure 56: DEFRA's carbon emission conversions for distribution (Adapted from DEFRA n.d.)

The total carbon emission reduction from the *plan* case study is 116 tonnes per annum, representing a 19 per cent reduction in annual carbon emissions. The detailed carbon emission contribution per DC can be found in Appendix F.

Table 10: *Plan* case study: Overall carbon emission reduction

Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on one return trip per DC per week to the CDC)*	2 385 469
Kilometres travelled Proposed annually *(based on one return trip per DC per week to the CDC)*	1 920 547
Kilometres reduction annually	464 922
Current carbon emissions (tons) annually	596.3
Proposed carbon emissions (tons) annually	480.1
Carbon emission reduction (tons) annually	116.2
% Carbon emission reduction	**19%**

4.2.2.2 *Plan* case study summary

The case study shows that GreenSCOR can be used to identify the best practices related to a process, and that the DEFRA (n.d.) can be used to calculate carbon emissions. However, the Green Business Profitability Framework combines Life Cycle Assessment (LCA), product costing, the 'cost to serve' methodology, Activity Based Costing (ABC) costing, Business Profitability Modelling (BPM), DEFRA, and GreenSCOR to understand and quantify the impact of green initiatives on company profitability. The final results of applying the Green Business Profitability Framework are summarised in Table 11. It is clear that DC 1 has the largest impact on business profitability and carbon emissions. DC 2 has a reduction in cost and an increase in profitability, but the carbon emissions increase by one per cent, and more kilometres are driven. DC 4 also has high carbon emission reductions as well as variable transport cost savings – mainly due to the reduction in kilometres travelled.

Table 11: *Plan* case study results per annum

	DC 1	DC 2	DC 3	DC 4
Fixed secondary transportation cost	36%	29%	1%	0%
Variable transportation cost	26%	4%	1%	11%
Business profitability increase (gross profit)	0.029%	0.001%	0.012%	0.003%
Carbon Emission reduction %	36%	-1.00%	13%	18%
Kilometer reduction	5 377	-42	2 367	1 239
	1	4	3	2

The reduction in kilometres travelled through optimising the secondary transportation network is directly related to the carbon emissions, but not to the increase in business profitability. In the scenario, the net effect will be a reduction of carbon emissions and an increase in business profitability; however, DC2 will increase its carbon emissions and kilometres driven, based on the network optimisation.

4.2.3 Case study: *Source*

The *Source* case study focuses on determining the financial and environmental impact of considering different strategic plans for a future co-manufacturing facility location. The aim of this case study is to determine whether the framework can successfully aid the company's strategic planning.

The case study company currently sources raw materials for the co-manufactured product from farms located in the Free State, Mpumalanga, and Northern Cape provinces of South Africa. The product is manufactured by suppliers in the Free State and Western Cape provinces. With increasing demand, there are various options to increase manufacturing capacity in other provinces, while limiting the cost and environmental impact of the supply chain. These options include investing in a manufacturing facility in the North West province, increasing capacity in the Western Cape province, or increasing capacity in Kwazulu-Natal (KZN) province.

To investigate this issue, the various alternatives are modelled and compared with the current network to determine potential cost savings. MS Excel and JDA SCS (JDA, n.d.) are used for the analysis. MS Excel is used to capture the data and map the current flow of products from the factory to the customers. SCS uses the data imported from MS Excel, and the entity and relationship tables in SCS, to create the current network and also to determine where it would be most suitable to invest in a manufacturing plant or to increase current manufacturing capability. The model includes raw material sourcing, current manufacturing constraints, demand from customers, and available transportation options.

The current service area per manufacturing plant is mapped using SCS, and shown in Figure 57. The blue marked area represents the Western Cape manufacturing facility's current service area, and green indicates the Free State manufacturing facility's current service area.

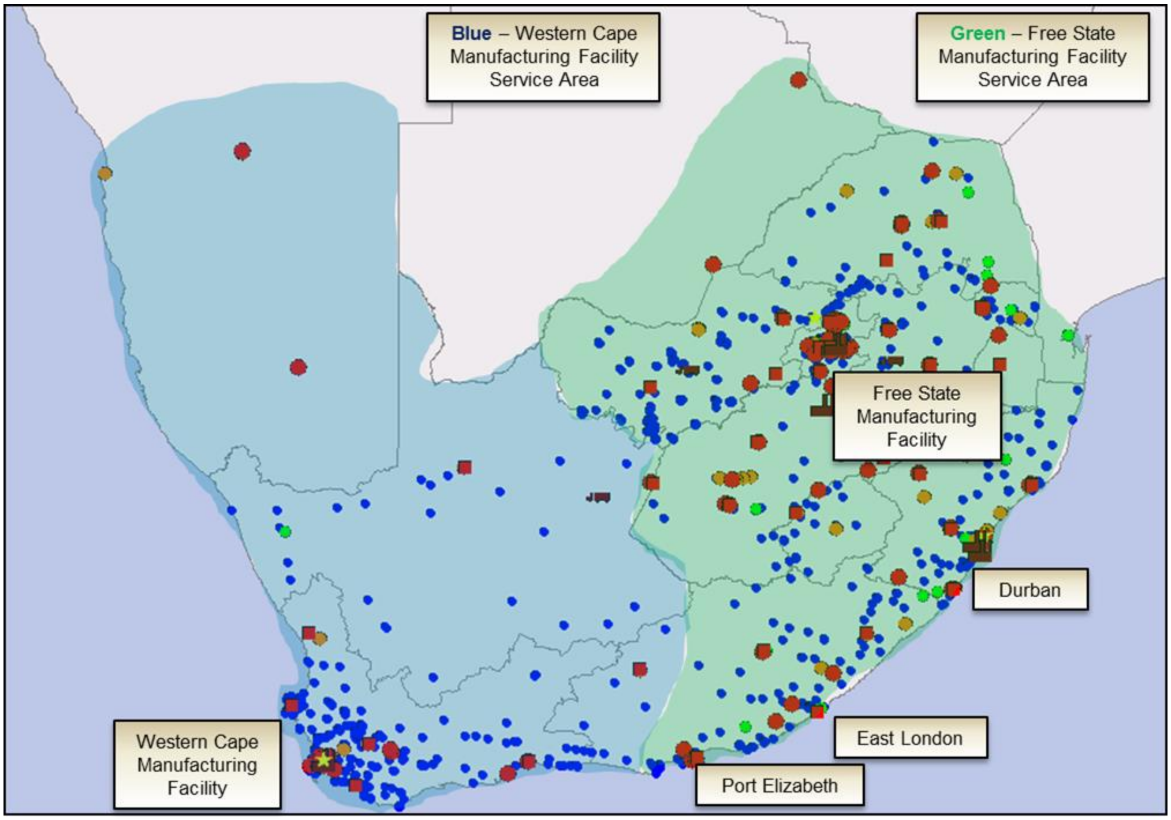


Figure 57: *Source* case study: Current co-manufacturing network and service area per plant

Scenario 1:

To add capacity in KZN and to service additional customers as far away as Harrismith – along with some Eastern Cape customers – from that facility could result in a R6.3 million per annum cost saving. This could bring a R4.6 million manufacturing cost saving, R1.22 million primary transport saving, and R515 200 warehouse cost saving. Figure 58 illustrates the customers and service area for the proposed KZN co-manufacturing facility.

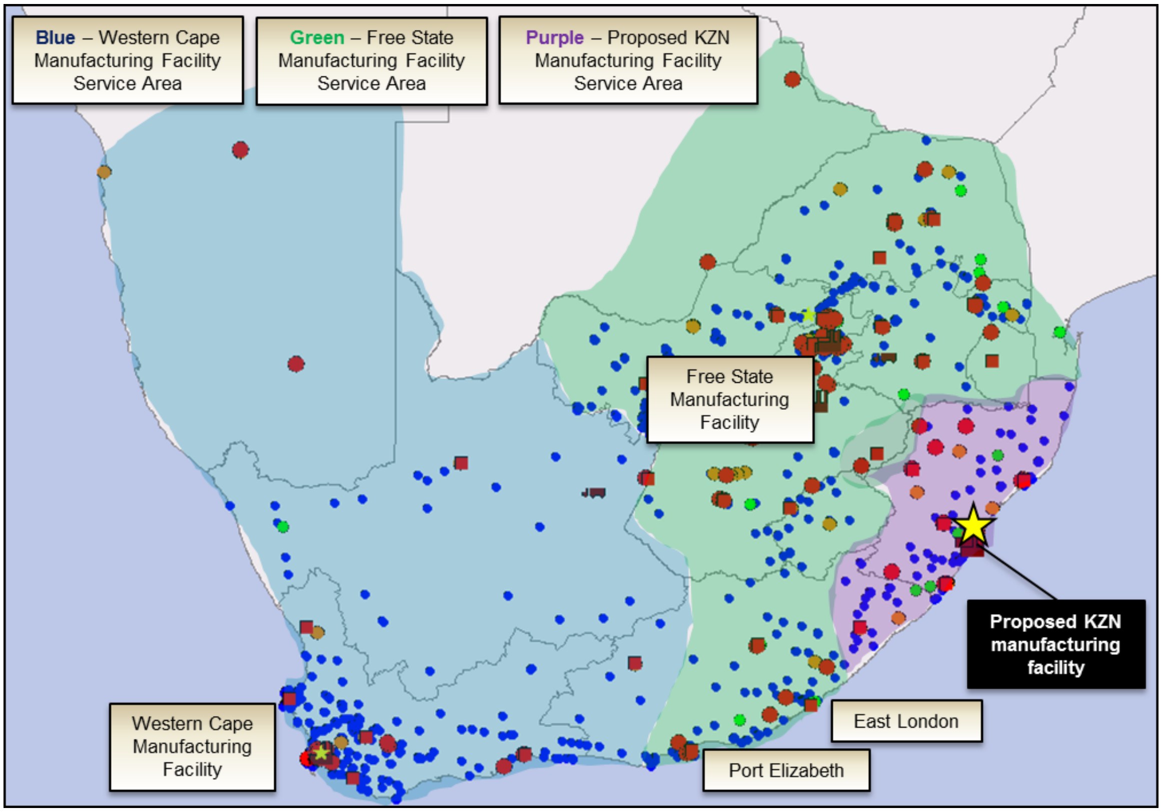


Figure 58: *Source* case study: Proposed co-manufacturing KZN facility and service area

Scenario 2:

The second scenario investigates the opportunity to add additional co-manufacturing capacity in the Western Cape and to extend the Western Cape service area up to East London. The potential cost saving is R25.6 million per annum, made up of an R18 million manufacturing cost, a R5.6 million transportation cost, and a R2 million warehouse cost. Figure 59 illustrates the increased Western Cape service area (marked in orange).

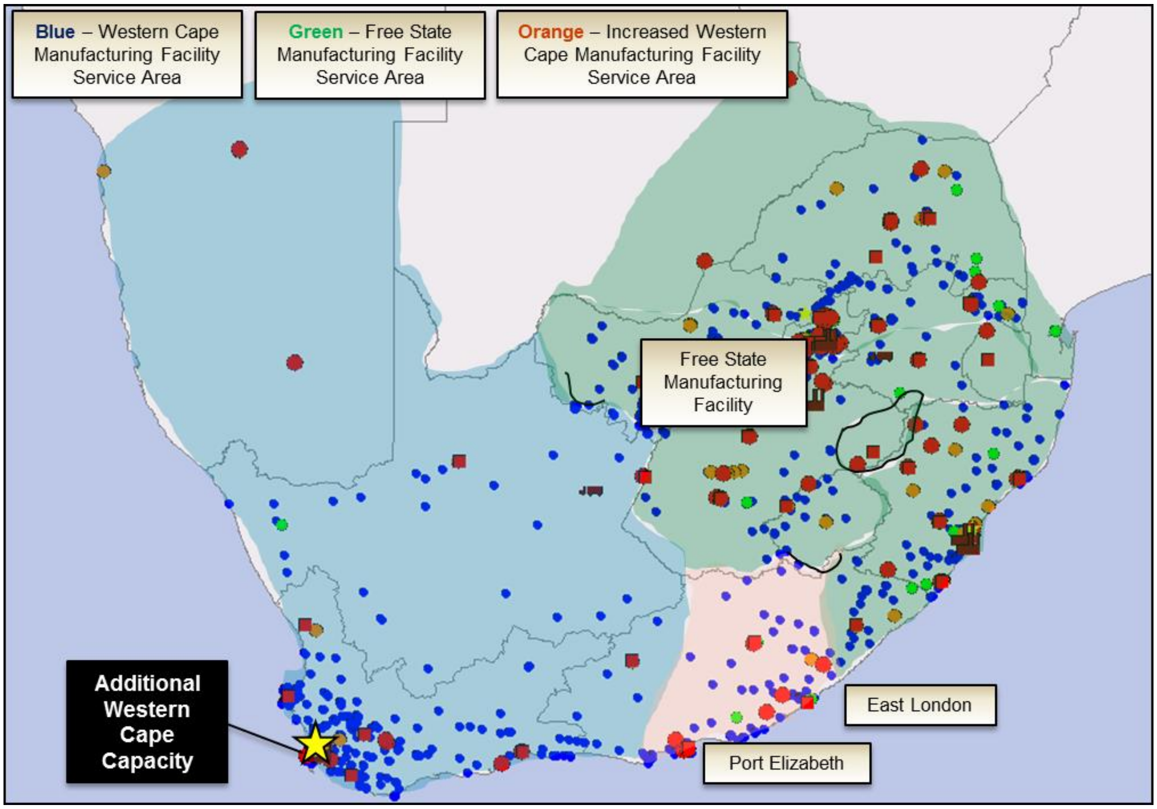


Figure 59: *Source* case study: Extra Western Cape manufacturing capacity and increased service area

Scenario 3:

The third scenario investigates the opportunity to build a new manufacturing facility in the North West province. The potential cost saving from incorporating the North West manufacturing facility into the network is R9.01 million per annum, from a manufacturing cost saving of R6.6 million, a transportation cost saving of R 1.5 million, and a warehouse cost saving of R910 628 per annum. Figure 60 illustrates the new service area for the North West manufacturing facility (in brown) and the reduced service area for the current Free State manufacturing facility (in green).

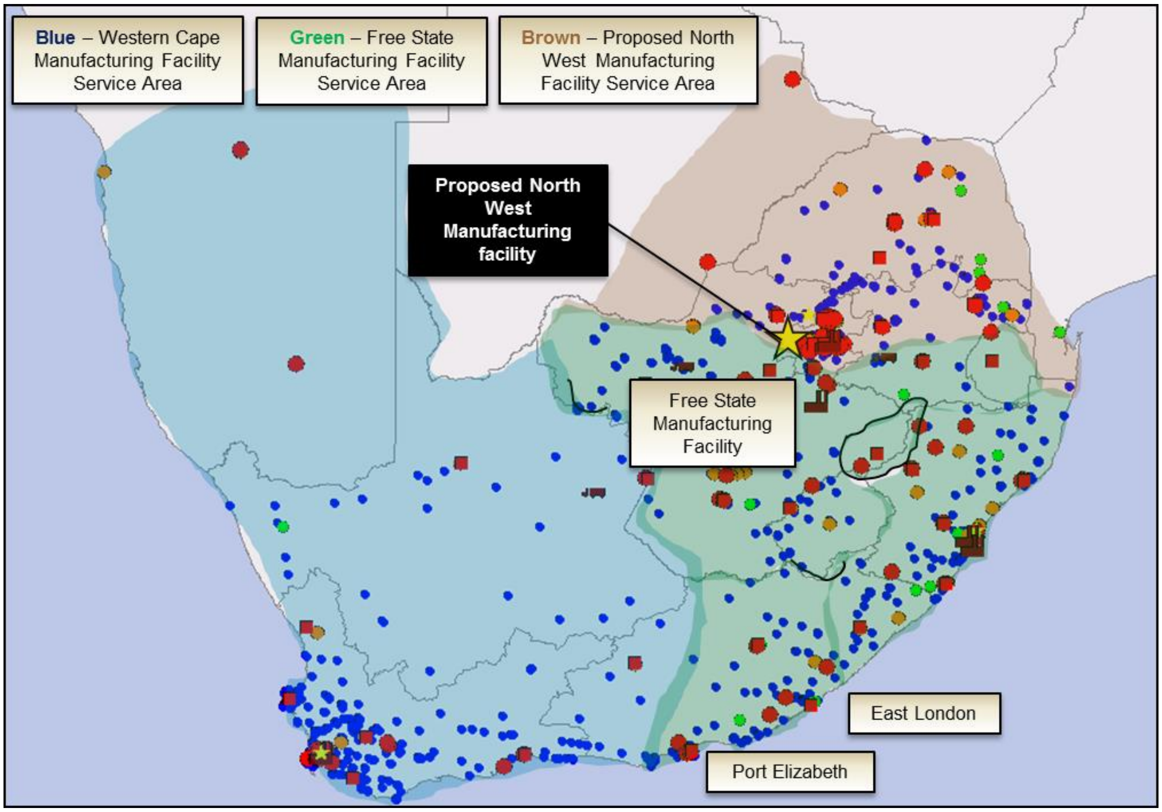


Figure 60: *Source* case study: Potential North West co-manufacturing facility and smaller Free State facility service area

The results of the three scenarios are summarised as follows:

- Additional capacity in KZN province and expanding the KZN customer region to include the Eastern Cape province could result in an annual cost saving of R6.3 million, from a R4.6 million manufacturing cost saving, a R1.22 million primary transport saving, and a R515 200 warehouse cost saving.
- Additional co-manufacturing capacity in the Western Cape province and extending the Western Cape service area could bring an annual cost saving of R25.6 million, made up of a R18 million manufacturing cost saving, a R5.6 million transportation cost saving, and a R2 million warehousing cost saving.
- The third scenario investigates the opportunity to build a new manufacturing facility in the North West province. The potential annual cost saving is estimated to be R9.01 million, from a manufacturing cost saving of R 6.6 million, a transportation cost saving of R1.5 million, and a warehouse cost saving of R910 628.

The financial and environmental impact per scenario is analysed using the Green Business Profitability Framework.

4.2.3.1 Green Business Profitability Framework – *Source*

Best practices (Appendix B, section 8.1) are linked to the sourcing practices by using GreenSCOR. The suggested best practices (*relevant team member executes deliveries for different customers*) link to the level 2 process *bundle deliveries*. From there this links to the level 3 process (*source stocked product*) and into the process *source carbon emissions*. This contributes to the overall L1 process (*total supply chain carbon footprint*). In the case study, the Green Business Profitability Framework uses the best practice of the GreenSCOR model as a guideline for reviewing network designs in the three scenarios. Figure 61 summarises the best practices related to the *source* process of the SCOR model.

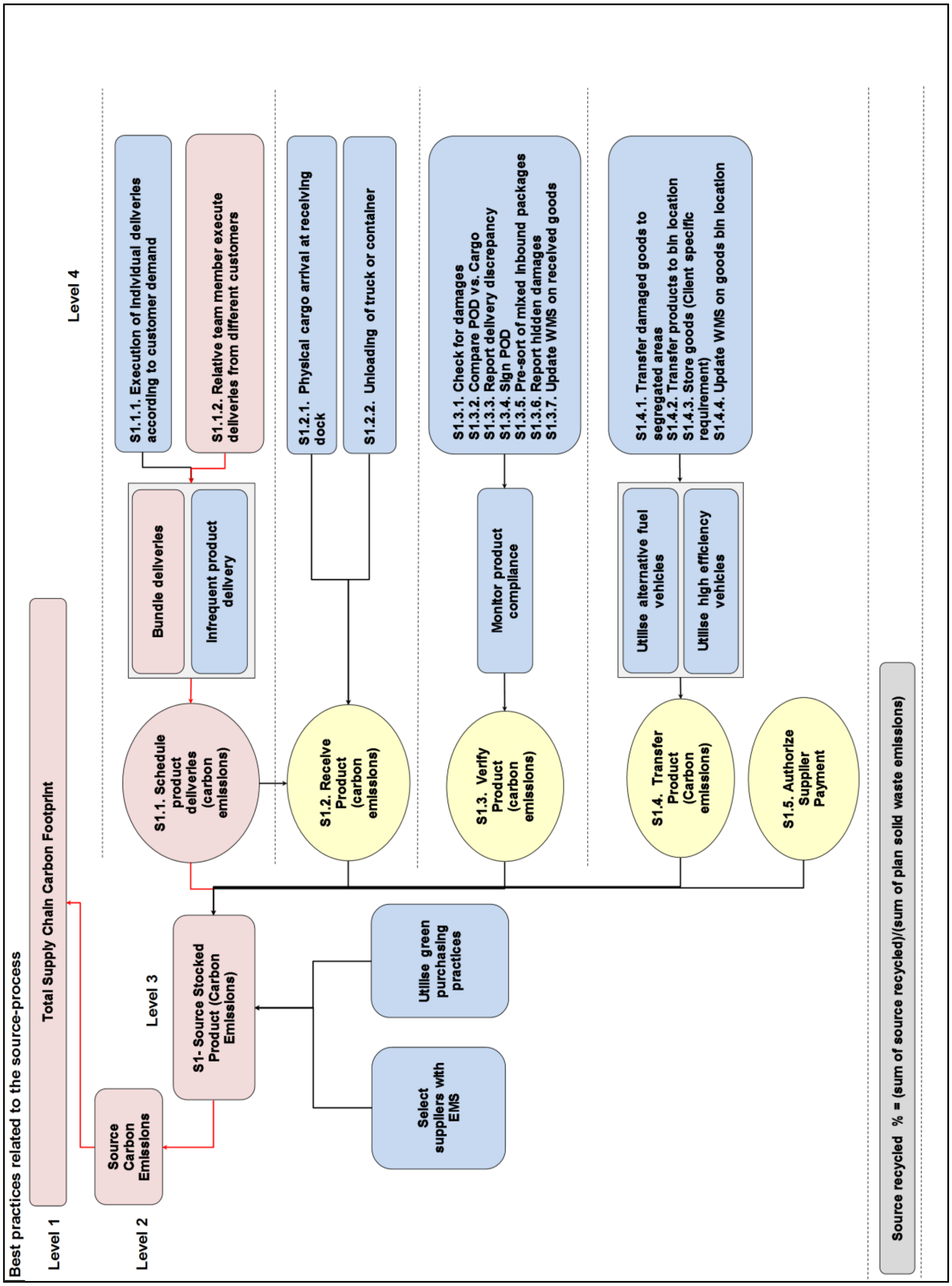


Figure 61: Best practices related to the *source* process of the SCOR model

Scenario 1:

The manufacturing cost impact influences GP1, the warehouse cost saving influences GP2, and the transport cost saving influences GP3. The GP1 increase of 0.1 per cent comes from the decrease in the manufacturing cost of R 4.6 million, due to the lower rate input manufacturing cost.

The Green Business Profitability Framework results indicate that GP2 increases by 0.21 per cent, which represents a R515 200 storage cost saving, and transportation cost decreases by R1.2 million, causing an increase of GP3 by 0.26 per cent. The total impact is a cost saving of R6.3 million, which increases the total company profitability by 0.26 per cent (Figures 62 and 63). Figures 64 and 65 illustrate the difference in the profitability per business level. The highlighted cells indicate the impact on GP3 and GP6.

The number of kilometres driven directly influences the amount of fuel used, thus increasing the amount of carbon emissions. The total $kgCO_2e$ produced by travelling from the CDCs to the customers and back is calculated and summarised into an overall impact. The carbon emission impacts of all three scenarios are calculated using the Green Business Profitability Framework, and the same DEFRA (n.d) conversion factors are used as in the *Plan* case study (refer to Figure 56). To calculate the $kgCO_2e$, the reduced distance of 539 795 km is multiplied by the carbon emissions factor of 0.24999 for vehicles of up to 3.5 tonnes, and the answer is converted to tonnes. The annual carbon emission reduction for scenario 1 is 135 tonnes, which contributes 20 per cent towards the annual carbon emission. Table 12 summarises the overall impact of the carbon emission reduction. From this figure it can be seen that the carbon emission reduction for scenario 1 is 135 tonnes per annum, which contributes 20 per cent towards the annual carbon emission.

As-Is Cost:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921	563 684 708	25.8%	213 844 382	349 840 326
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.9%	8 527 141	38 058 358
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25.1%**	**222 371 522**	**387 898 685**

Source Scenario 1 Modelling:
With manufacturing, primary transportation and warehouse cost changes etc.:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 372 511 626	815 366 896	37%	99 054 977	716 311 919	33%	147 019 089	569 292 830	26.0%	213 844 382	355 448 448
Business Level 2	351 953 029	105 644 221	246 308 808	161 791 027	84 517 781	34%	6 277 425	78 240 356	32%	30 947 779	47 292 577	19.2%	8 527 141	38 765 437
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 534 302 653**	**899 884 677**	**37%**	**105 332 402**	**794 552 275**	**33%**	**177 966 868**	**616 585 407**	**25%**	**222 371 522**	**394 213 885**

COGS saving	**4 600 000**	Storage cost saving	**515 200**	Delivery cost saving	**1 200 000**
Difference in GP1	**0.19%**	Difference in GP2	**0.21%**	Difference in GP3	**0.26%**

Figure 62: *Source* case study SC 1: GP1 to GP3 impact

As-Is Cost:

Business Level	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	349 840 326	16%	129 317 122	220 523 204	10%	49 524 273	170 998 932	7.8%	49 664 510	27 016 594
Business Level 2	38 058 358	15%	16 162 569	21 895 789	9%	9 987 184	11 908 605	4.8%	6 204 324	3 396 348
	387 898 685	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**	**30 412 942**

Source
With

Business Level	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	355 448 448	16%	129 317 122	226 131 326	10%	49 524 273	176 607 054	8.1%	49 664 510	27 016 594
Business Level 2	38 765 437	16%	16 162 569	22 602 867	9%	9 987 184	12 615 683	5.1%	6 204 324	3 396 348
	394 213 885	**16%**	**145 479 691**	**248 734 194**	**10%**	**59 511 457**	**189 222 737**	**8%**	**55 868 835**	**30 412 942**

	1 200 000
	0.26%

Total cost saving	**6 315 200**
Difference in GP6	**0.26%**

Figure 63: *Source* case study SC 1: GP6 impact of 0.26 per cent and total saving of R6 million

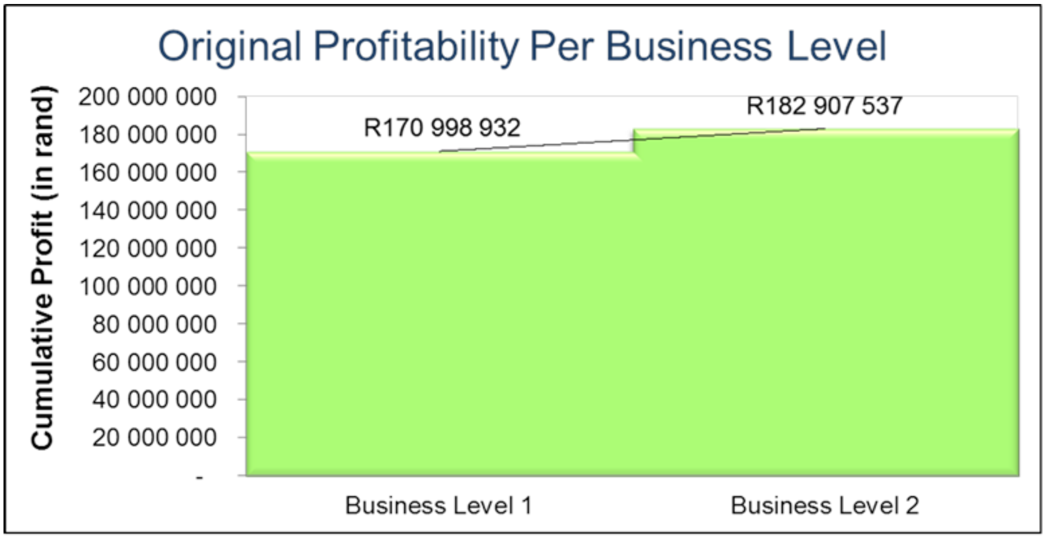


Figure 64: *Source* case study: Scenario 1 As-is GP6 values per business level

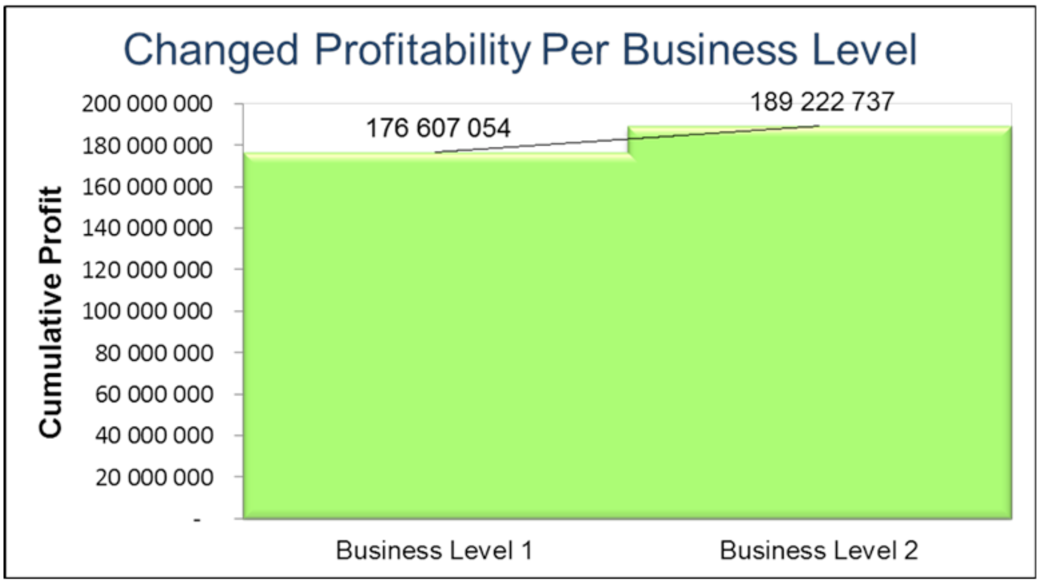


Figure 65: *Source* case study: Scenario 1 GP6 values per business level

Table 12: *Source* case study: Scenario 1: Overall reduction of carbon emission by adding a co-manufacturer in KZN

Carbon emission conversion:	
kgCO_2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on the current network*	2 724 490
Kilometres travelled Proposed annually *(based on Scenario 1 of a KZN comanufacturer)*	2 184 695
Kilometres reduction annually	539 795
Current carbon emissions (tons) annually	681
Proposed carbon emissions (tons) annually	546
Carbon emission reduction (tons) annually	135
% Carbon emission reduction	**20%**

Scenario 2:

The extra co-manufacturing capacity results in a manufacturing cost saving of R18 million, which increases the GP1 by 0.74 per cent – although this is dependent on the manufacturing cost that the co-manufacturer can charge. The storage cost impact is a saving of R2 million, and the transportation cost reduces by R5.6 million. The overall impact is a total cost saving of R25.6 million and a total company profitability increase of 1.05 per cent. The output from the Green Business Profitability Framework is displayed in Figures 66 and 67. Figures 68 and 69 illustrate the difference in the profitability per business level. The highlighted cells indicate the impact on the GP 3 and GP6.

Carbon emissions will increase by 19 tonnes per annum (3 per cent), due to a 74 191 km increase in the annual kilometres travelled. The potential annual cost saving of this scenario (R25.6 million) seems very attractive, but implementing this scenario will have a bigger impact on the environment through increased carbon emissions. Table 13 summarises the overall impact of the carbon emissions reduction.

As-Is Cost:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4	GP4%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921	563 684 708	25.8%	213 844 382	349 840 326	16%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.9%	8 527 141	38 058 358	15%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25.1%**	**222 371 522**	**387 898 685**	**16%**

Source Scenario 1 Modelling:

With manufacturing, primary transportation and warehouse cost changes etc.:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4	GP4%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 360 629 922	827 248 600	38%	97 658 665	729 589 934	33%	143 188 038	586 401 896	26.8%	213 844 382	372 557 514	17%
Business Level 2	351 953 029	105 644 221	246 308 808	160 272 731	86 036 077	35%	6 188 937	79 847 140	32%	30 378 829	49 468 311	20.1%	8 527 141	40 941 170	17%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 520 902 653**	**913 284 677**	**38%**	**103 847 602**	**809 437 075**	**33%**	**173 566 868**	**635 870 207**	**26%**	**222 371 522**	**413 498 685**	**17%**

COGS saving	**18 000 000**	Storage cost saving	**2 000 000**	Delivery cost saving	**5 600 000**
Difference in GP1	**0.74%**	Difference in GP2	**0.82%**	Difference in GP3	**1.05%**

Figure 66: *Source* case study SC 2: GP6 impact of 1.05 per cent and total saving of R25.6 million

As-Is Cost:

Business Level	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	349 840 326	16%	129 317 122	220 523 204	10%	49 524 273	170 998 932	7.8%	49 664 510	27 016 594
Business Level 2	38 058 358	15%	16 162 569	21 895 789	9%	9 987 184	11 908 605	4.8%	6 204 324	3 396 348
	387 898 685	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**	**30 412 942**

Source
With

Business Level	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	372 557 514	17%	129 317 122	243 240 392	11%	49 524 273	193 716 120	8.9%	49 664 510	27 016 594
Business Level 2	40 941 170	17%	16 162 569	24 778 601	10%	9 987 184	14 791 417	6.0%	6 204 324	3 396 348
	413 498 685	**17%**	**145 479 691**	**268 018 994**	**11%**	**59 511 457**	**208 507 537**	**9%**	**55 868 835**	**30 412 942**

	GP4
	5 600 000
	1.05%

Total cost saving	**25 600 000**
Difference in GP6	**1.05%**

Figure 67: *Source* case study SC 2: GP6 impact of 1.05 per cent and total saving of R25.6 million

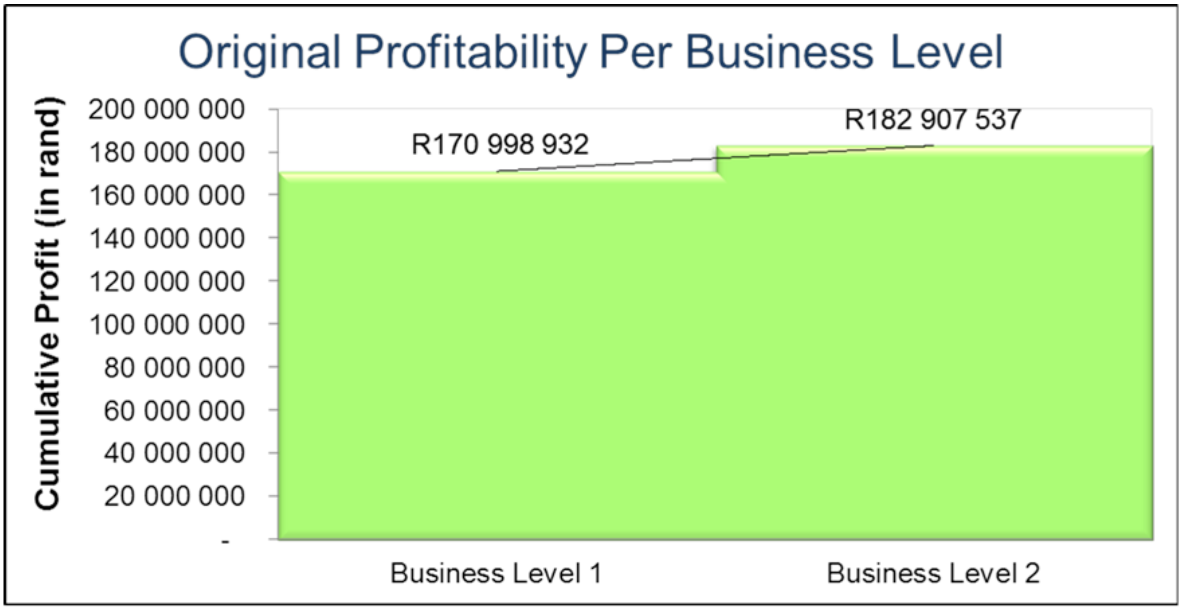


Figure 68: *Source* case study: Scenario 2 As-is GP6 values per business level

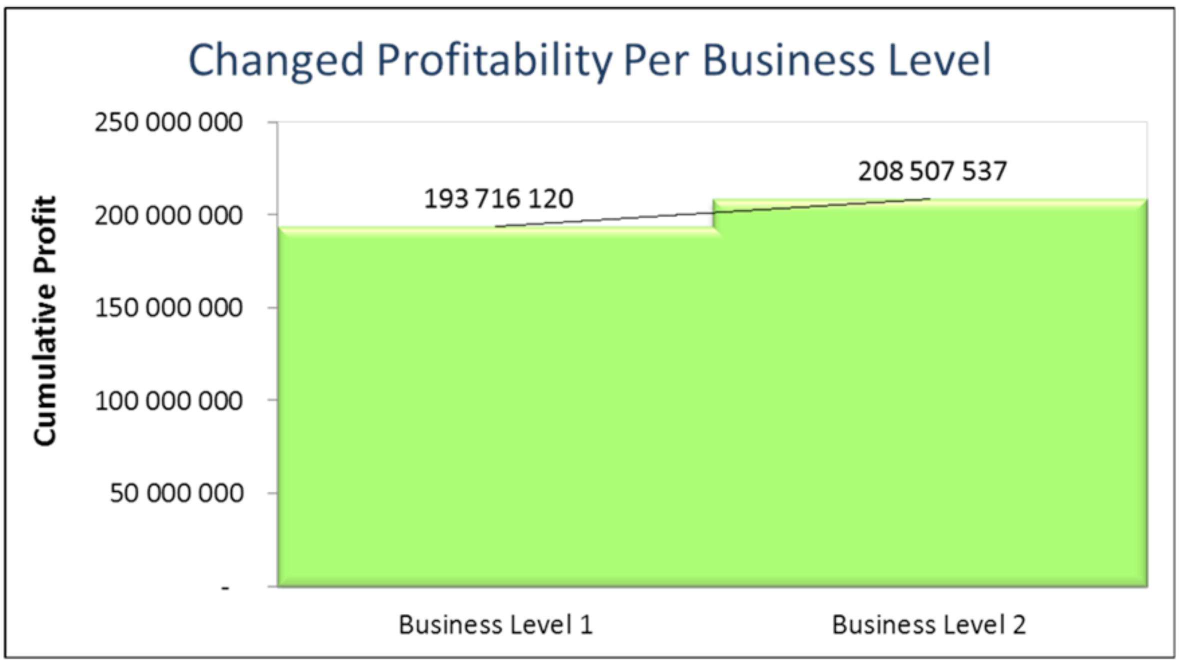


Figure 69: *Source* case study: Scenario 2 Scenario 2 GP6 values per business level

Table 13: *Source* case study: Scenario 2 Overall reduction of carbon emissions from an additional co-manufacturer in the Western Cape

Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on the current network*	2 724 490
Kilometres travelled Proposed annually *(based on Scenario 1 of a KZN comanufacturer)*	2 798 681
Kilometres increase annually	74 191
Current carbon emissions (tons) annually	681
Proposed carbon emissions (tons) annually	700
Carbon emission increase (tons) annually	19
% Carbon emission increase	**3%**

Scenario 3:

The extra co-manufacturing facility in the North West province results in a total cost saving of R9 million, which results in an overall 0.37 per cent gross profit increase. The production cost reduces by R6.6 million, the storage cost by R910 628, and the transportation cost by R1.5 million. The carbon emissions will increase by 41 tonnes per annum (6 per cent) due to an increase in the distance covered annually (an annual increase of 165 449 km). Figures 70 and 71 illustrate the output of the Green Business Profitability Framework, and Figures 72 and 73 show the difference in the profitability per business level from applying the proposed changes. The highlighted cells indicate the impacts on the GP 3 and GP6.

As-Is Cost:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4	GP4%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921	563 684 708	25.8%	213 844 382	349 840 326	16%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.9%	8 527 141	38 058 358	15%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25.1%**	**222 371 522**	**387 898 685**	**16%**

Source Scenario 1 Modelling:

With manufacturing, primary transportation and warehouse cost changes etc.:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing	GP4	GP4%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 370 738 237	817 140 284	37%	98 683 115	718 457 170	33%	146 757 881	571 699 288	26.1%	213 844 382	357 854 907	16%
Business Level 2	351 953 029	105 644 221	246 308 808	161 564 416	84 744 392	34%	6 253 859	78 490 533	32%	30 908 987	47 581 546	19.3%	8 527 141	39 054 406	16%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 532 302 653**	**901 884 677**	**37%**	**104 936 974**	**796 947 703**	**33%**	**177 666 868**	**619 280 835**	**25%**	**222 371 522**	**396 909 313**	**16%**

COGS saving	**6 600 000**	Storage cost saving	**910 628**	Delivery cost saving	**1 500 000**
Difference in GP1	**0.27%**	Difference in GP2	**0.31%**	Difference in GP3	**0.37%**

Figure 70: *Source* case study SC 3: GP6 impact of 0.37per cent and total saving of R9 million

As-Is Cost:

Business Level	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	349 840 326	16%	129 317 122	220 523 204	10%	49 524 273	170 998 932	7.8%	49 664 510	27 016 594
Business Level 2	38 058 358	15%	16 162 569	21 895 789	9%	9 987 184	11 908 605	4.8%	6 204 324	3 396 348
	387 898 685	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**	**30 412 942**

Source Scenario 1
With manufacturing.

Business Level	GP4	GP4%	Admin & Overheads	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	357 854 907	16%	129 317 122	228 537 785	10%	49 524 273	179 013 512	8.2%	49 664 510	27 016 594
Business Level 2	39 054 406	16%	16 162 569	22 891 837	9%	9 987 184	12 904 652	5.2%	6 204 324	3 396 348
	396 909 313	**16%**	**145 479 691**	**251 429 622**	**10%**	**59 511 457**	**191 918 165**	**8%**	**55 868 835**	**30 412 942**

	GP4	GP6
	1 500 000	
	0.37%	
Total cost saving		**9 010 628**
Difference in GP6		**0.37%**

Figure 71: *Source* case study SC 3: GP6 impact of 0.37 per cent and total saving of R9 million

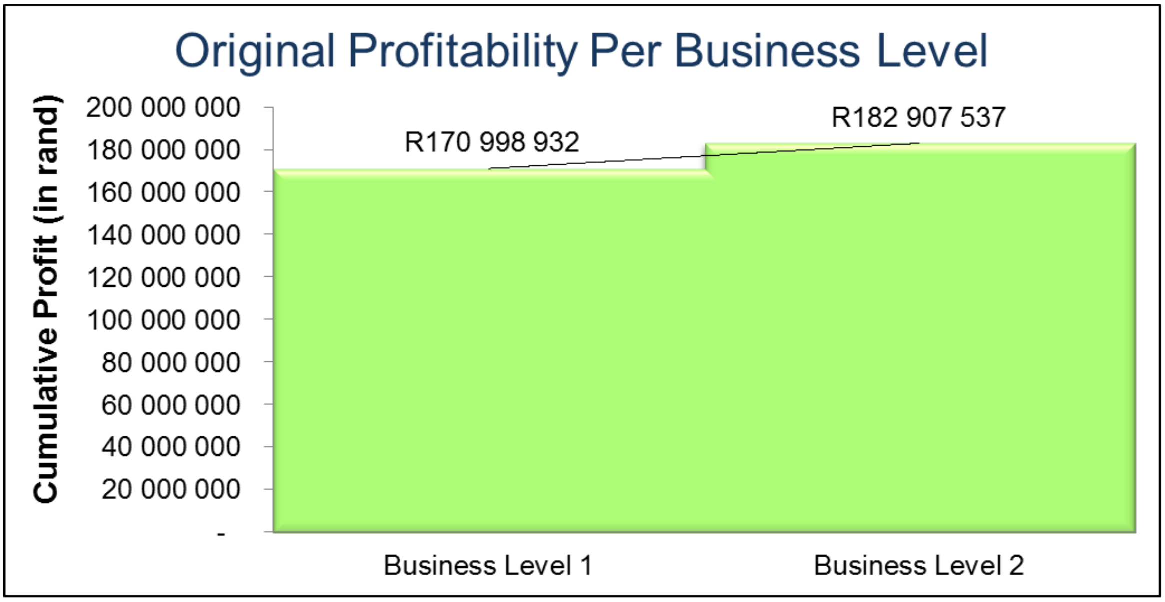


Figure 72: *Source* case study: Scenario 3 As-is GP6 values per business level

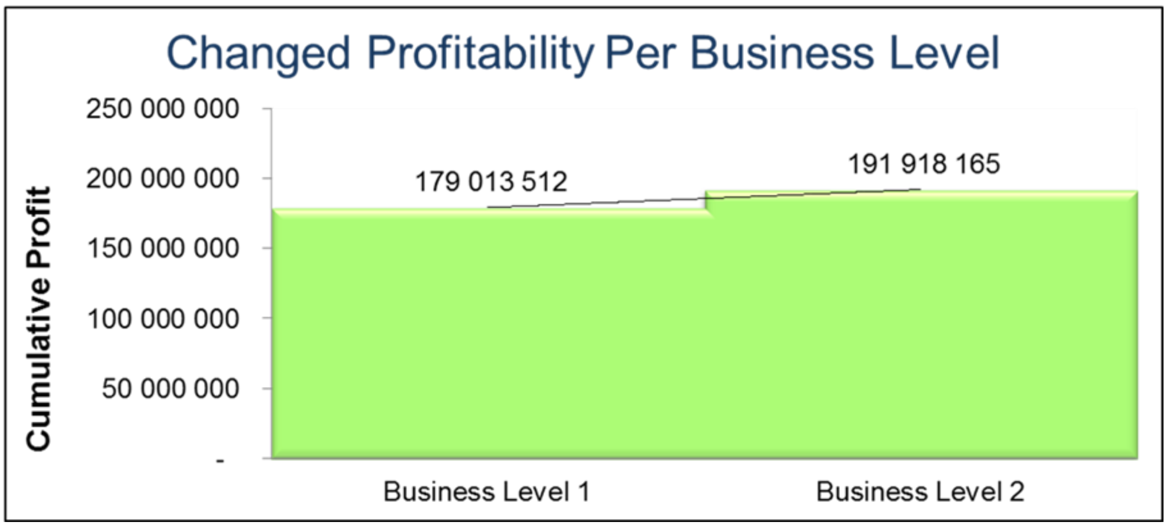


Figure 73: *Source* case study: Scenario 3 GP6 values per business level

Table 14 summarises the overall impact of the increase in carbon emissions. They increase by 41 tonnes (6 per cent) per annum when implementing the proposed scenario. This is due to an increase of 165 449 km in the annual distance travelled.

Table 14: *Source* case study: Scenario 3 Overall reduction of carbon emissions from building a new co-manufacturing facility in the North West

Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on the current network*	2 724 490
Kilometres travelled Proposed annually *(based on Scenario 1 of a KZN comanufacturer)*	2 889 989
Kilometres increase annually	165 499
Current carbon emissions (tons) annually	681
Proposed carbon emissions (tons) annually	722
Carbon emission increase (tons) annually	41
% Carbon emission increase	**6%**

4.2.3.2 *Source* case study summary

The *Source* case study evaluated the suitability of using the Green Business Profitability Framework to create a five-year strategic roadmap. The results of the case study showed that GreenSCOR can be used to identify the best practices related to a process, and that the DEFRA carbon emission conversions (n.d.) can be used when calculating carbon emissions.

The results of applying the Green Business Profitability Framework in the three scenarios are given in Table 15. Depending on the decision-making priorities, different scenarios can be recommended. If the priority is to have an option that is more environmentally-friendly, using the co-manufacturer in the KZN province (Scenario 1) would be best, as it increases business profitability by 0.26 per cent and has a carbon reduction of 20 per cent in the overall network. If the aim is to rather to optimise business profitability and limit the environmental impact as much as possible, the option to have additional manufacturing capacity in the Western Cape (scenario 2) must be considered.

The results indicate that the impact on profitability is not directly related to carbon emissions and, in some instances, there will indeed be a trade-off between profitability and sustainability.

Table 15: *Source* case study results per annum

	Scenario 1	**Scenario 2**	**Scenario 3**
Cost of goods sold (COGS) decrease	0.30%	1.20%	0.40%
Storage cost change decrease	0.50%	1.90%	0.90%
Delivery cost change decrease	0.70%	3.10%	0.80%
Business profitability increase (gross profit)	0.26%	**1.05%**	0.37%
Carbon Emission Reduction	**20.00%**	**-3.00%**	**-6.00%**
	3	1	2

4.2.4 Case study: *Make*

The *make* case study is applied to the Johannesburg manufacturing facility in various areas of the production line, and includes quantifying the business profitability and environmental impact of some initiatives identified by McComb (2013) in a study conducted on behalf of the CSIR. This study considered various sustainability initiatives for both electrical and LPG energy in the current Gauteng-based manufacturing facility.

4.2.4.1 *Make* case study electrical energy reduction initiatives

The electrical energy reduction initiative considers various recommendations, including tariff consolidation, air compressor heat recovery, compressed air leaks, air compressor pressure reduction, extruder motor, and energy-efficient lights.

Tariff consolidation

McComb (2013) discovered that the case study company pays three different tariffs for electricity supplied to the Johannesburg plant. The cheapest tariff is R0.80 per kWh for the main feed of 1500kVa (kilovolt ampere), with the 800kVa to 100kVA feeds charged between R0.88 and R0.98 per kWh. Combining the feeds into a single supply line would therefore result in a saving of between R0.08 and R0.18 per kWh. This translates into an estimated monthly saving of between R4 980 and R27 600.

In addition, combining the feeds could reduce the peak time demand of 100kVa, potentially saving another R2 400 per month – an estimated annual saving of R360 000.

Air compressor heat recovery

McComb (2013) states that the geysers, showers and boilers can use the recovered capacity of the air compressors to operate, which is estimated to be around 70 per cent of the initial capacity. This result in 115.5 kilowatt (kW) output that could power the geyser and solar panel elements of the geysers (estimated to be around 66kW). There would also be a reduction in the cooling load for the air compressor, which is around 20kW; and that would reduce the amount of LPG gas used.

The installation cost of such a recovery system is estimated at R90 000, and the potential saving per year as a result of this system is estimated at R180 000, equating to 345 000 kWh and 159 435 (159 tonnes) savings annually (refer to Table 16).

Table 16: kWh conversion from DEFRA's carbon emissions conversions (Adapted from DEFRA n.d.)

Electricity Usage							
Activity	**Country**	**Unit**	**Year**	**kg CO_2e**	**kg CO_2**	**kg CH_4**	**kg N_2O**
Electricity generated	Electricity: UK	**kWh**	**2015**	**0.46213**	0.45844	0.00035	0.00334

The payback period of the investment, as determined by McComb (2013), would be 0.5 years. However, payback calculations only indicate how fast a company can recover from an investment, and do not measure the project's total profitability (Averkamp 2015). Payback period calculations should therefore use cash flows rather than net income in the calculation.

The true impact of the investment and the saving on the company is more accurately measured by considering the project's total profitability. Therefore the Green Business Profitability Framework will be applied to the case study to determine the total profitability impact of the initiative.

Compressed air leaks

Currently the case study company does not run any compressed air leak and detection programmes. The norm for air leakage for companies that monitor it is 10 per cent; but for companies that do not monitor, it is between 20 to 30 per cent. McComb (2013) suggests that the 50 per cent reduction in compressed air leakage that can be realised by monitoring it would result in a monthly saving of 10 000 kWh.

McComb (2013) recommends a R12 000 investment to realise a 172 400 kWh (R90 000) and a 79 671 $kgCO_2e$ (79 tonnes) saving per annum. The payback for the investment is therefore estimated at 0.13 years.

Air compressor pressure reduction

McComb (2013) reports that compressed air is used for the filling lines operating pneumatic valves, which require a pressure of 2 bar. To reduce the system operating pressure by 1 bar, the compressor demand needs to reduce by 7 to 10 per cent. Currently 7 bar is used by the air compressor, but could be reduced to 6.5 bar. There is also an option to replace the compressed air lines with a blower that has a lower pressure. This would require a R30 000 investment, and could save 63 200 kWh per annum – an annual saving of R33 000 and 29 207 $kgCO_2e$ (29 tonnes). The payback for the air compressor pressure reduction initiative is therefore estimated to be 0.9 years.

Extruder motor

One of the manufacturing lines has an extruder that is driven by belt drives and other old equipment. Slippages with these belts result in losses. However, these losses could be minimised by using cogged V-belts. It is therefore recommended that these motors be replaced with directly-driven high efficiency motors that could result in a 2.5 per cent efficiency improvement. The motor currently uses 96 000 kWh per month, so a 5 per cent efficiency improvement would result in a reduction of 4300 kWh per month. The potential savings are therefore estimated to be R26 400 per annum in cost (51 600 kWh) and 23 846 $kgCO_2e$ (23 tonnes) per annum in emissions (McComb 2013).

Energy-efficient lighting in high bays

The lights in the factory are 400 megavolts (MV), which is equal to 400-watt lights that operate 24 hours per day all year round. The factory has 484 of these lights that are operational during the day. An extra 63 lights operate at night. A possible replacement bulb option is the pulse metal halide bulb of 200 watts. Induction bulbs are another option, and part of an Eskom retrofit project that aims to provide incentives for changing lighting. The induction bulbs have a lower efficiency, measured in lumens per watt, but they only have a lamp life of about 60 000 hours (McComb 2013).

Venture Lighting (n.d.) state that some of the advantages of the pulse metal halide bulb are a longer bulb life, increased quality, light that is closer to sunlight than any other high intensity discharge (HID) light source, and lower electricity-generating requirements. The halide bulb has a lamp life of 40 000 hours – longer than other bulbs with a lamp life of between 16 000 and 24 000 hours. McComb (2013) adds that the disadvantage is that they have a restrike time (the time from being turned off after being on for a long time, and then cooling down sufficiently before it can be switched on again) of two to three minutes. But that is still better than the MV400s, with a restrike rate of between four and seven minutes.

Table 17 shows the details of the calculation for the monthly and annual savings when comparing the day and night operations (McComb 2013). The power consumption of the 400 MV lights is compared with the pulse metal halide bulb (200 watts). Spend is calculated using the actual power usage, cost per kWh, and the utilisation ratio. Results indicate that a saving of R395 457 per year can be realised for the day shift and R25 737 for the night shift. The total annual saving is R421 194, with an initial investment cost of R138 840, resulting in a payback period of 0.3 years. The estimated kWh saving of this initiative is 900 000 kWh per annum, and the emission saving is 415 917 kgCO_2e (415 tonnes) per annum.

Table 17: Wattage reduction calculation detail for day and night shift operation (Adapted from McComb 2013)

Day operational lights

Power (kW)	Quantity	Utilisation Ratio	Working hours per week	Weeks	Monthly Electricity (kWh)	R/month	R/Year
0.4	484	1	168	4.33	140 832	65 909	790 915
0.2	484	1	168	4.33	70 416	32 955	395 458

Night shift operational hours, extra lights

Power (kW)	Quantity	Utilisation Ratio	Working hours per week	Weeks	Monthly Electricity (kWh)	R/month	R/Year
0.4	63	1	84	4.33	9 166	4 289	51 475
0.2	63	1	84	4.33	4 583	2 145	25 738

Electrical energy initiative summary

Table 18 summarises the total savings from the electrical energy initiatives. The tariff consolidation, compressed air leaks, and energy-efficient lighting in high bays are the easiest to implement, while air compressor pressure reduction, air compressor heat recovery, and extruder motor installation will require more work to implement. The total annual saving from implementing all the above-mentioned initiatives would be R839 760. The details of the saving and carbon emission calculations are displayed per electrical energy initiative in Figure 74.

Type	Recommendations	Investment	Saving	Estimated kWh savings	Payback period (years)	Ease of implementation (1 - easy, 3 - medium, 5 - hard)
Electrical Energy Recommendations	Tariff consolidation	-	600 000	-	n/a	1
	Air compressor heat recovery	150 000	300 000	345 000	0.50	3
	Compressed air leaks	20 000	150 000	172 400	0.13	1
	Air compressor pressure reduction	50 000	55 000	63 200	0.90	2
	Extruder motor	n/a	44 000	51 600	n/a	3
	Energy efficient lighting in high bays	231 400	702 000	900 000	0.32	1
		451 400	**1 851 000**	**1 532 200**		

Electricity Usage

Activity	Country	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Electricity generated	Electricity: UK	kWh	2015	0.46213	0.45844	0.00035	0.00334

Total kWH saving	1 532 200	kWh
Converted to kgCO_2e	708 076	kgCO2e

Figure 74: Electricity saving calculation – Conversion to kgCO2e

The total saving on carbon emissions is 708 076 kgCO_2e (708 tonnes), to which the initiatives investigating energy-efficient lighting in high bays would make the biggest contribution. The last column indicates how easy it would be to implement the initiatives, ranked from '1' for the easiest to '5' for the hardest.

Table 18: Summary of the total energy and kgCO2e savings per initiative (Adapted from McComb 2013)

Type	Recommendations	Investment	Saving	Estimated kWh savings	Estimated kgCO2e savings	Payback period (years)	Ease of implementation (1 - easy, 3 - medium, 5 - hard)
Electrical Energy Recommendations	Tariff consolidation	-	600 000	-	-	n/a	1
	Air compressor heat recovery	150 000	300 000	345 000	159 435	0.50	3
	Compressed air	20 000	150 000	172 400	79 671	0.13	1
	Air compressor pressure reduction	50 000	55 000	63 200	29 207	0.90	2
	Extruder motor	n/a	44 000	51 600	23 846	n/a	3
	Energy efficient lighting in high bays	231 400	702 000	900 000	415 917	0.32	1
		451 400	**1 851 000**	**1 532 200**	**708 076**		

4.2.4.2 *Make* case study LPG reduction initiatives

The LPG reduction initiatives include fryer or oven combustion efficiency, line damper and burner on a specific manufacturing line, preheat combustion air, insulation of steam pipes and valves, steam leaks, condensate return, oil recirculation insulation, waste to energy, and CO_2 recovery recommendations.

Fryer or oven combustion efficiency

McComb (2013) conducted a full gas usage analysis of the three different manufacturing lines in the Johannesburg manufacturing facility. Table 19 summarises the gas usages per manufacturing line.

Table 19: Gas usage per manufacturing line

Manufacturing Line	Temperature (Degrees Celsius)	Oxygen (O_2)	Carbon Dioxide (CO_2)	Carbon Monoxide (CO) (ppm)	Efficiency
Manufacturing Line 1	280	7.3%	11.9%	5	76%
Manufacturing Line 2	309	11.2%	8.5%	174	70%
Manufacturing Line 3	208	17%	3.5%	4	69%

The efficiencies of manufacturing lines 2 and 3 are below the acceptable norm, whereas manufacturing line 1 operates at an acceptable efficiency. If the combustion efficiency could be improved by 2 per cent, this would result in a potential saving of R360 000 per annum. To convert the gigajoule (GJ) saving into carbon emissions, the DEFRA (n.d) framework will be used. Tables 20 and 21 display the factors that are used for the conversion. 1GJ is equal to 277.78kWh; this factor will then be multiplied by 525 GJ, and subsequently converted from kWh to kgCO_2e. The annual saving is estimated to be 525 GJ, or 31 631 kgCO_2e (31tonnes).

Table 20: GJ to kWh conversion (Adapted from DEFRA n.d.)

		GJ	kWh	therm	toe	kcal
Energy	Gigajoule, GJ		277.78	9.47817	0.02388	238 903
	Kilowatt-hour, kWh	0.0036		0.03412	0.00009	860.05
	Therm	0.10551	29.307		0.00252	25 206
	Tonne oil equivalent, toe	41.868	11 630	396.83		10 002 389
	Kilocalorie, kcal	0.000004186	0.0011627	0.000039674	0.000000100	

Table 21: kWh to kgCO2e conversion (Adapted from DEFRA n.d.)

Electricity Usage

Activity	Country	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Electricity generated	Electricity: UK	kWh	2015	0.46213	0.45844	0.00035	0.00334

Line damper and burner on a specific manufacturing line

The oil heating burner of the manufacturing line is clogged with oil, resulting in reduced air flow through the burner. Figure 75 below shows the burner intake.

Figure 75: Burner intake (Adapted from McComb 2013)

The line has a 20m^3 per hr (R88 per hr) consumption and losses of around 5 per cent. It is possible to install a duct intake with a saving of approximately R15 000 per annum and a once-off installation cost of R30 000. The payback period for the investment will therefore be two years. To convert the GJ saving to kgCO_2e, the same DEFRA (n.d.) conversion factors used in section 4.2.4 are used. This results in an estimated saving of 1506 kgCO_2e annually (McComb 2013).

Preheat combustion air

To optimise the overall use of combustion energy and to be more efficient, the combustion air can be preheated. An increase in temperature of 60 degrees Celsius can still be within manageable tolerance levels without impacting the burner's operation. The idea is to install an economiser on the line to transfer heat to the boiler and the oil-heating burners. The staff showers and cleaning of the plant can use the condensate (McComb 2013).

This could result in a 3 per cent reduction of fuel consumption, translating into a R600 000 per annum saving. The price estimation per stack is about R480 000, and the installation cost another R120 000. The payback period is therefore estimated to be one year. Using DEFRA (n.d) conversion factors, the estimated saving is 900 GJ, translating into 54 225 kgCO_2e.

Insulation - steam pipes and valves

McComb (2013) mentions that the insulation in the steam pipes is directly linked to steam energy losses and usage. Poor insulation in the facility's current steam pipes accounted for more than 18 per cent of the energy steam usage, and could be reduced through effective insulation by at least 50 per cent, equal to 2000m^3 per month. Figure 76 shows uninsulated steam lines and a heat map illustrating the heat loss of the steam line. Valves can be insulated using removable 'jackets', as illustrated in Figure 77 below. The insulation will cost R36 000, and the saving is estimated at R72 000 per year. The payback term of the investment is 0.6 years, with an annual saving of 100 GJ. This is converted to 6 025 kgCO_2e per annum using the DEFRA (n.d) factors.

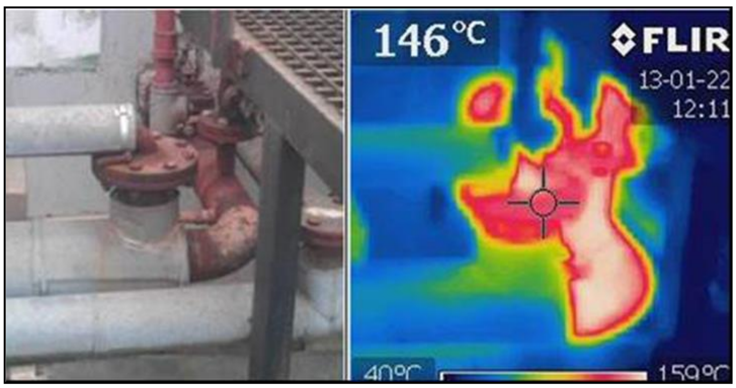


Figure 76: Uninsulated steam lines (Adapted from McComb 2013)


Figure 77: Example of valve insulation (Adapted from McComb 2013)

Steam leaks

The current manufacturing facility has a number of steam leaks at joints or steam traps that are visible to the naked eye. Around 4.7 per cent of the steam (15 kg per hour) is lost through these cracks. McComb (2013) adds that, to prevent steam leaks, all steam traps should be tested with ultrasound or the conductivity method at least once a year. To fix and maintain the current steam leaks will cost R36 000, and the annual savings are estimated to be about R36 000. The payback for the investment is one year. The saving will be 50 GJ, which converts to 3 012 kgCO_2e annually.

Condensate return

McComb (2013) reports that the current plant has no direct steam injection application; and so the assumption is that at least 85 per cent of the condensate must be returned to the hot well. After investigation it was established that only 55 per cent of the condensate was returned to the hot well. McComb (2013) add that the current return lines are poorly insulated, resulting in heat loss along the line and lower temperatures at the boiler. When an effective return system is implemented, this can result in a 35 per cent increase in condensate and a reduction in fuel consumption of at least 5.3 per cent.

Increasing the insulation in the return lines requires an investment of at least R54 000, with estimated savings of R36 000 per year and a payback of 1.5 years. The saving will be 50GJ, which translates to 3 012 kgCO_2e annually.

Oil recirculation insulation

Another area in which to improve insulation is the valves and pipes on the oil circulation loop. The removable jackets shown in Figure 77 above can also be used over the valves to increase insulation, and uninsulated pipes should be properly insulated to avoid heat loss. Figure 78 illustrates the heat map of uninsulated pipes, and Figure 79 shows the heat map of uninsulated valves (McComb 2013).

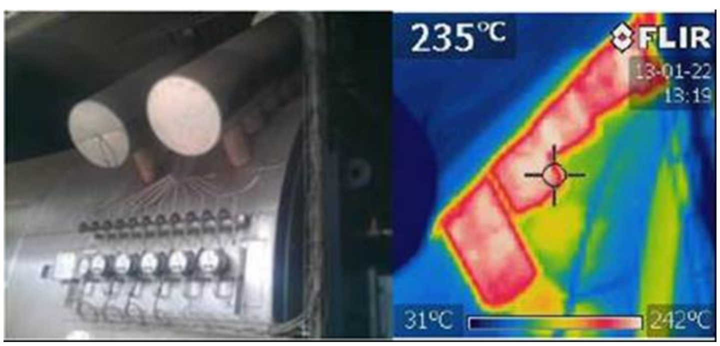


Figure 78: Heat map of uninsulated pipes (Adapted from McComb 2013)

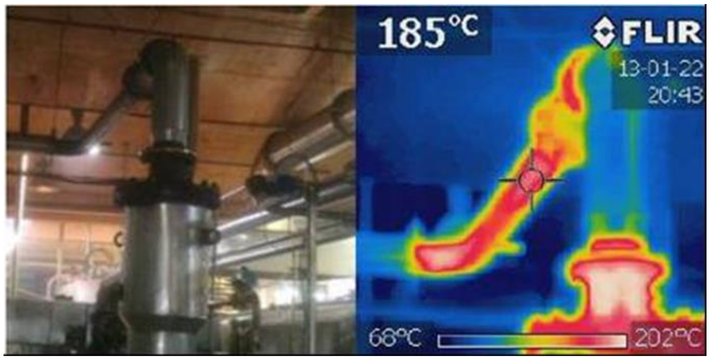


Figure 79: Heat map of uninsulated valves (Adapted from McComb 2013)

McComb (2013) add that the current estimation of radiation loss due to poor insulation on the oil circulation loop is around 300kW. This accounts for about 2.5 to 5 per cent of the gas used. The investment cost is estimated to be R300 000, and the saving would be R600 000 per year. The payback is therefore 0.5 years, with an annual saving of 900 GJ or 54 225 kgCO_2e.

Waste to energy

McComb (2013) mentions that the manufacturer uses film for the outer packaging of products, and that the film scrap rate is very high. The wasted film amounts to about 40 tonnes per month at the Johannesburg manufacturing facility; but it could be used for the pyrolysis process. Zafar (2015) explains that biomass pyrolysis can be either a small- or a large-scale operation, and works by converting biomass to a liquid that is easily transported and that can then be used to generate power. He adds that food and beverage packaging is different from other plastics because the plastic is attached to other materials such as aluminium and polymer laminate. Pyrolysis of plastics can be used to recover synthetic fuel and dispose of waste. Diesel generator fuel and fuel for burners are uses of the pyrolysis oils recovered from the process.

The Biofuels Academy (n.d.) summarises the basic steps in the pyrolysis of plastic process, illustrated in the flow diagram in Figure 80. The first step is to heat the plastic evenly, and then to begin the process of eliminating oxygen (O_2) from the pyrolysis chamber. The next step is to manage the by-product, known as carbonaceous char. The last step is the condensation and fractionation of the pyrolysis vapours to produce the distillate.

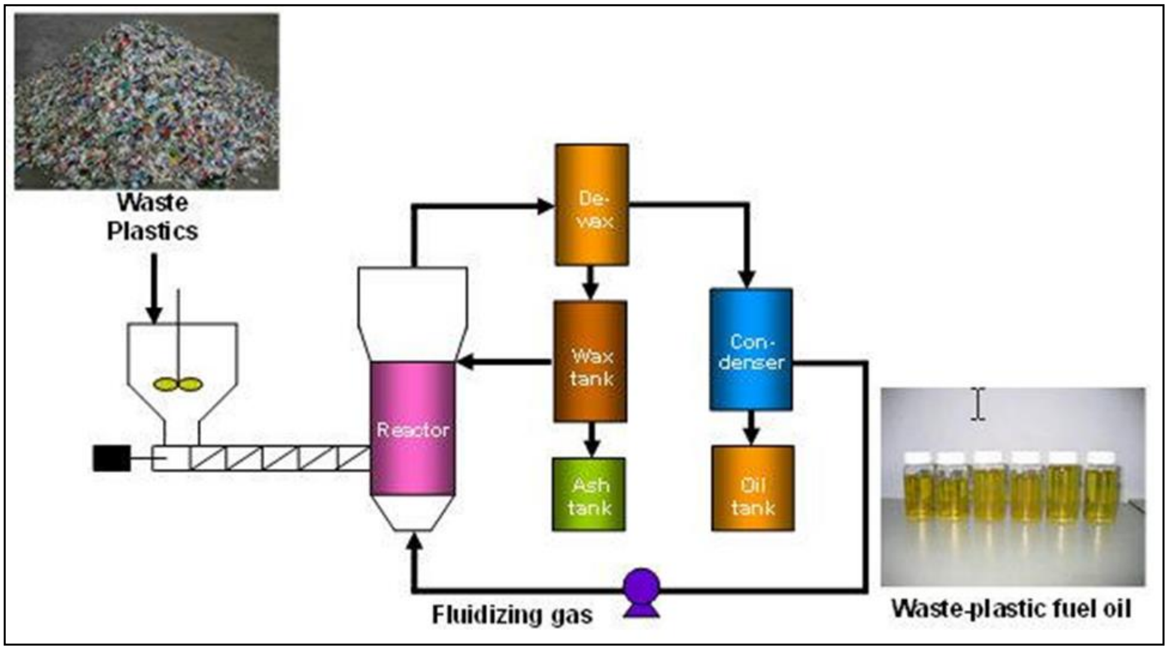


Figure 80: The process of waste plastic technology (Adapted from The Biofuels Academy 2015)

McComb (2013) states that the proposed pyrolysis process discussed above can generate around 576 GJ energy per month, and that this could be used by the fryer in the manufacturing facility. With the average cost of LPG gas, the gas saving is around R51 000 per month, and the electricity saving is R6 000 per month. Costs that must be considered are installation costs and the cost of conducting an energy information administration (EIA). There is no extra storage requirement because space is available with the existing LPG burner. The investment is estimated at around R1.5 million, with a saving of R540 000 per year. The payback period is 2.78 years, and the estimated annual saving is 800GJ, or 48 200 kgCO_2e.

Carbon dioxide (CO_2) recovery

McComb (2013) states that there is an option to recover the CO_2 emitted by the current operations and to sell it into the market. This is possible owing to the low sulphur level of the company's emissions. The current monthly CO_2 emissions are approximately 3 900 tonnes. McComb (2013) adds that building a plant next to the existing facility that would be able to recover 6 tonnes per hour would cost around R90 million. The estimated return, with a profit of R1 200 per ton, would be an estimated R3.6 million per month (R43.2 million per year), and the payback time would be two years.

LPG energy initiative summary

The impact of the LPG energy improvement suggestions is summarised in Table 22. The total energy saving from the LPG energy recommendations is 3350 GJ. The GJ unit can be converted to kWh and from there to kgCO_2e. The total potential kWh saving is 930 556 kWh and 201 838 kgCO_2e. Figure 81 summarises the detailed calculations. The last column indicates the ease of implementing the initiatives, ranked from '1' for the easiest to '5' for the hardest. The initiative to use waste as energy and to recover CO_2 will require the greatest amount of skill and time to implement.

Table 22: Summary of LPG energy saving initiatives

Type	Recommendations	Investment	Saving	Estimated Giga Joule (GJ) saving	Payback period (years)	Ease of implementation (1 - easy, 3 - medium, 5 - hard)
LPG Energy Recommendations	Fryer/ Oven combustion	n/a	360 000	525	n/a	2
	Line damper and burner on a specific manufacturing line	30 000	15 000	25	2.00	2
	Preheat combustion air	600 000	600 000	900	1.00	4
	Insulation – Steam pipes and valves	36 000	72 000	100	0.60	2
	Steam leaks	36 000	36 000	50	1.00	2
	Condensate return	54 000	36 000	50	1.50	3
	Oil recirculation insulation	300 000	600 000	900	0.50	2
	Waste to energy	2 500 000	900 000	800	2.50	5
		3 556 000	**2 619 000**	**3 350**		

Type	Recommendations	Investment	Saving	Estimated Giga Joule (GJ) saving	Payback period (years)	Ease of implementation (1 - easy, 3 - medium, 5 - hard)
	CO_2 Recovery	90 000 000	43 200 000	-	2.00	5
		90 000 000	**43 200 000**	**-**		

Conversion factor:

		GJ	kWh	therm	toe	kcal
Energy	Gigajoule, GJ		277.78	9.47817	0.02388	238 903
	Kilowatt-hour, kWh	0.0036		0.03412	0.00009	860.05
	Therm	0.10551	29.307		0.00252	25 206
	Tonne oil equivalent, toe	41.868	11 630	396.83		10 002 389
	Kilocalorie, kcal	0.000004186	0.0011627	0.000039674	0.000000100	

Giga Joule Total:	3 350	GJ
Giga Joule to kWh	930 556	kWh

(1GJ: 277.78 (kWh)

Figure 81: LPG energy saving calculation: Conversion to kWh

Implementing the waste-to-energy and CO_2 recovery recommendations requires major capital investment, and is not being considered in the short-term by the case study company. The investment for the remainder of the initiatives is R1 056 000, and the potential saving is R1 719 000. The net effect will be a total saving of R663 000, which is also suggested by McComb (2013).

4.2.4.3 Green Business Profitability Framework – *Make*

In this section, the effects of the initiatives (as discussed in Section 4.2.4) are evaluated using the Green Business Profitability Framework, and are compared with McComb's (2013) suggestions**.** The SCOR model's best practices that relate to the *make* process are summarised in Figure 82. The suggested best practice, *benchmark practices*, links to process *M1.3 Produce and test (carbon emissions),* which in turn links to the process *M1 Make to stock (carbon emissions)*; and this will link to the level 2 process of *make carbon emissions*, which will flow into the level 1 process *total supply chain carbon footprint*. In the case study, the Green Business Profitability Framework uses the best practice of the GreenSCOR model as a guideline to review the reduction in electricity use and the LPG initiatives. Van Zyl (2010) states that implementing the best practices of the SCOR model is directly related to improved supply chain efficiency.

The *total make carbon emissions* of the manufacturing case study include the electrical energy initiatives and the LPG energy initiatives, which are converted into carbon emissions using the DEFRA (n.d.) carbon emission framework. The total annual carbon emission saving for this case study is 910 tonnes.

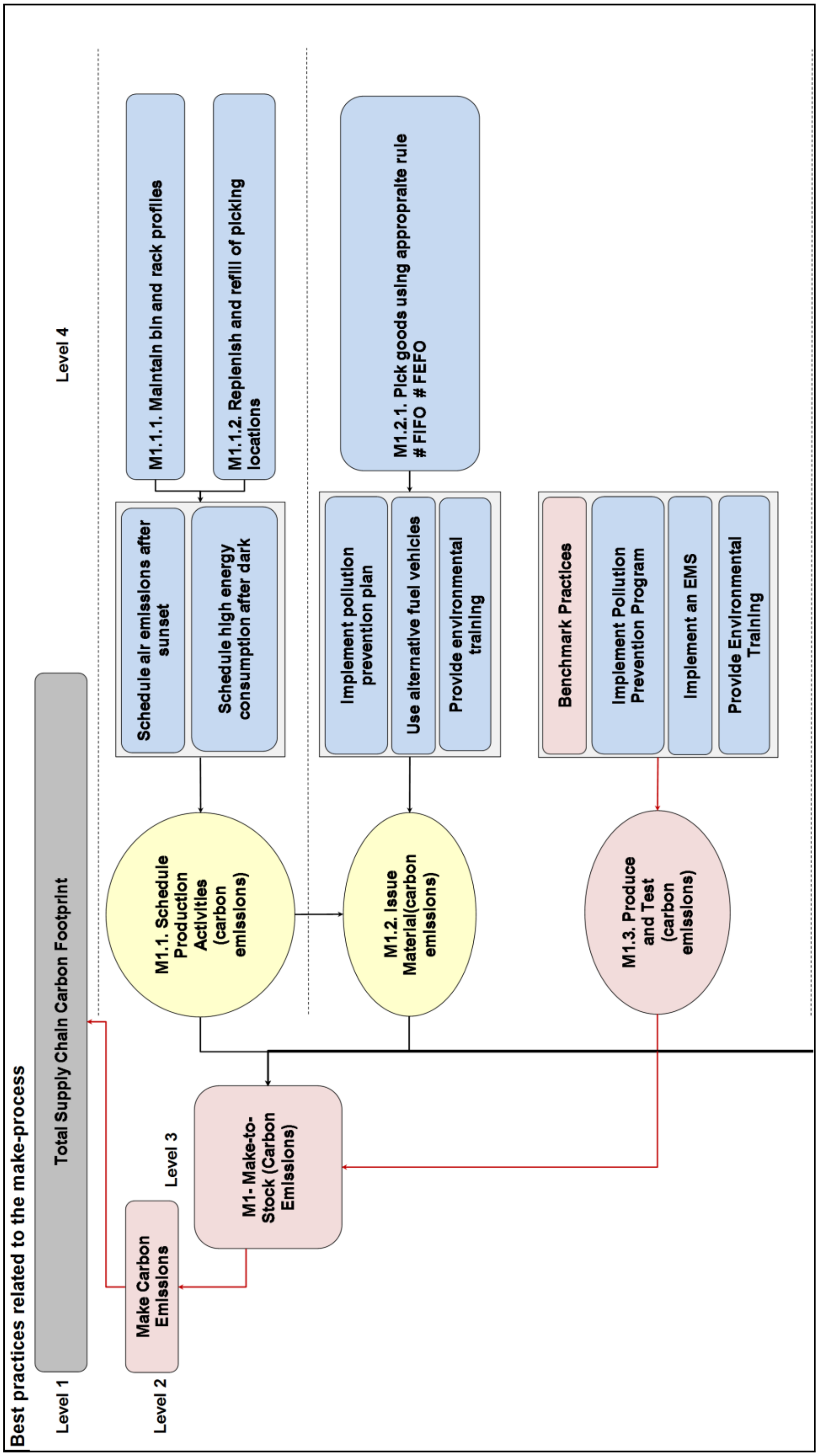


Figure 82: Best practices related to the *make* process of the SCOR model

The total annual cost and $kgCO_2e$ saving of the electrical energy initiatives is R839 760, and 708 076 $kgCO_2e$. The LPG gas saving is R663 000, and the carbon emission saving is 201 838 $kgCO_2e$. Both impact the total production cost – specifically, the variable MOH cost. The impact of the electricity and LPG gas intervention represents a R1 502 760 saving, and a total of 910 tonnes of carbon emissions savings per year.

This increases the business profitability by 0.06 per cent per annum, and impacts the GP1 level thanks to the COGS, which reduces by R1 502 760 per annum (net effect of savings and investment). The detail is given in Appendix G for the *make* case study. Figures 83 and 84 illustrate the change in business profitability per business level, and Figures 85 and 86 illustrate the change per sales region level.

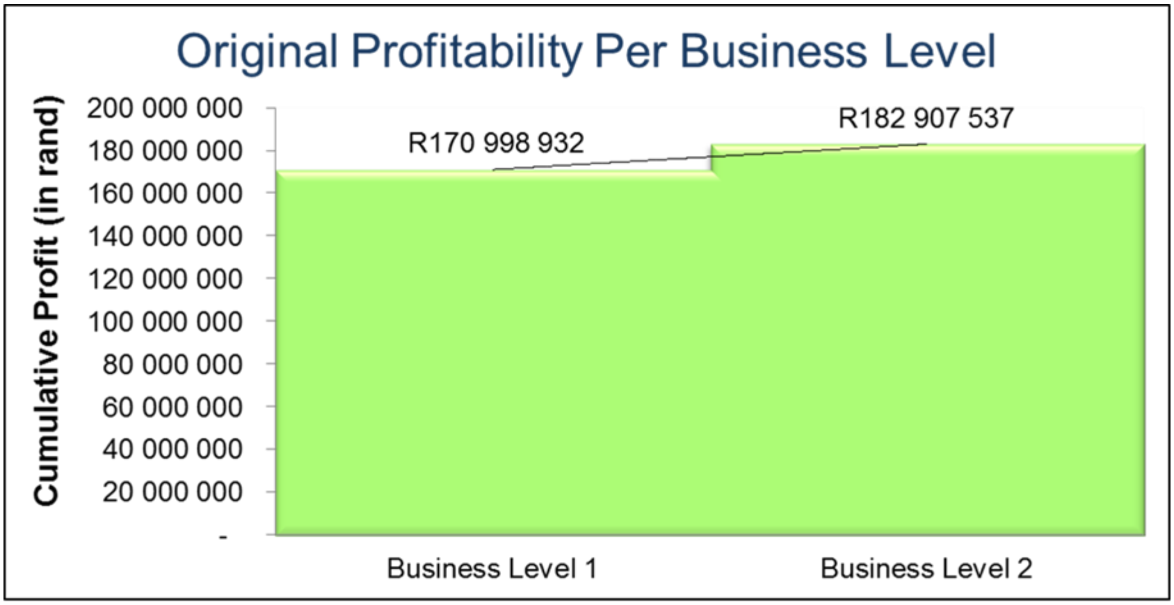


Figure 83: The original profitability per business level

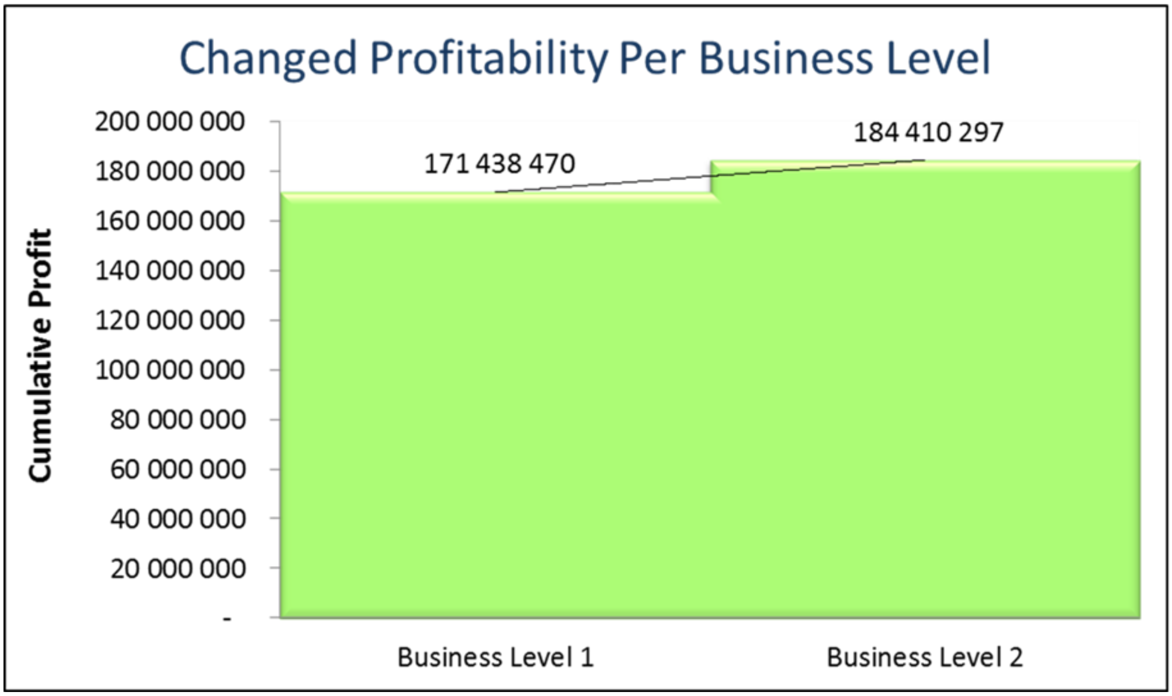


Figure 84: The change in profitability per business level

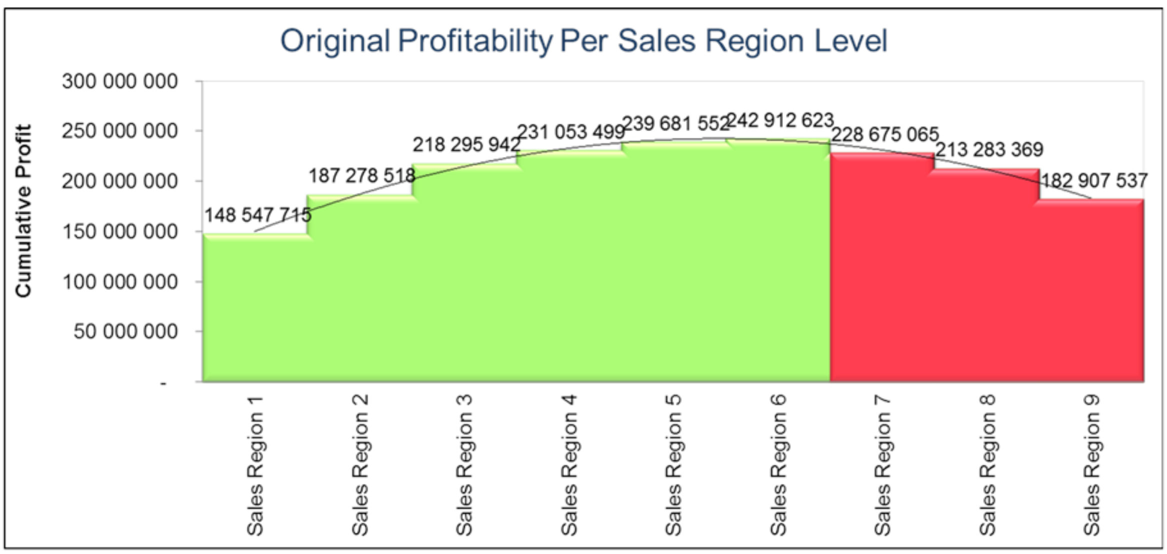


Figure 85: The original profitability per business level

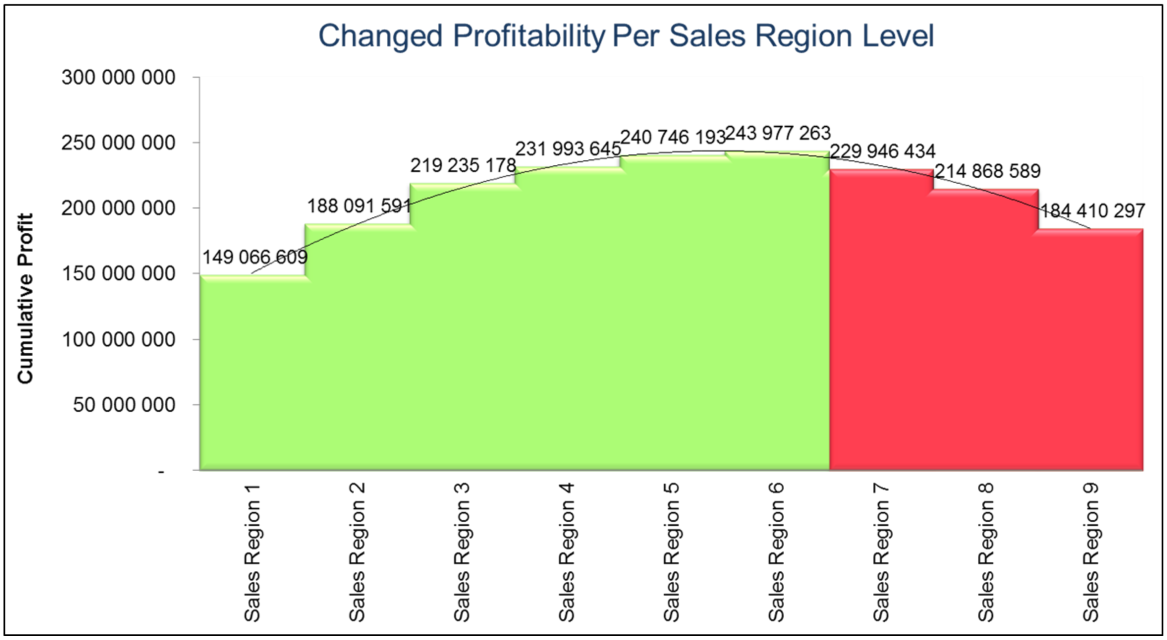


Figure 86: The change in profitability per business level

Business level 1 experienced a business profitability change of 0.02 per cent and business level 2 a change of 0.43 per cent. Sales region 1 experienced the highest change in business profitability – R518 894 (0.07 per cent) – and sales region 8 was second-highest with R313 851 (0.06 per cent). Table 23 illustrates the GP6 change per sales region.

Table 23: GP6 change per sales region level

Business Level	GP6	GP6%
Sales Region 1	518 894	0.07%
Sales Region 2	294 179	0.11%
Sales Region 3	126 163	0.06%
Sales Region 4	909	0.00%
Sales Region 5	124 495	0.08%
Sales Region 6	(0)	0.00%
Sales Region 7	206 729	0.06%
Sales Region 8	313 851	0.06%
Sales Region 9	(82 461)	-0.07%

The Green Business Profitability Framework can be applied to understanding the impact on business profitability at different levels, with the lowest being the business profitability impact per route level. The framework enables the business to understand the total business profitability impact, and also to quantify the green impact of the initiative. The recommendations of McComb (2013) have a total impact on the business, measured as an increase in profitability, of 0.06 per cent per annum; and the business can expect a total saving of R1 502 760 per annum.

4.2.4.4 *Make* case study summary

The effect of the initiatives identified by McComb (2013) on electricity and LPG gas consumption was investigated in the *make* case study. Table 24 summarises the findings. The initiatives to reduce electricity consumption include the consolidation of tariffs, heat recovery of the compressors, compressed air leakage reduction, pressure reduction of air compressors, replacement of the current extruder motors with directly-driven high efficiency motors, and energy-efficient lighting in high bays (McComb 2013). The combined impact of the identified initiatives is a reduction in COGS of 0.05 per cent, resulting in an increase of business profitability (gross profit) by 0.03 per cent and a carbon emission reduction of 10 per cent.

The recommendations by McComb (2013) to reduce the LPG gas consumption include increasing the fryer or oven combustion efficiency, installing a duct intake on a specific manufacturing line, preheating combustion air, insulating steam pipes and valves, reducing steam leaks, increasing the condensate return, and insulating the oil recirculation. The combined impact of this initiative reduced the COGS by 0.10 per cent, resulting in an increase in business profitability (gross profit) of 0.06 per cent per annum. The carbon emissions will reduce by 1.10 per cent per annum.

Table 24: *Make* case study results per annum

	Electricity Saving	LPG Gas Saving
Cost of goods sold (COGS) decrease	0.05%	**0.10%**
Business profitability increase (gross profit)	0.03%	**0.06%**
Carbon Emission reduction %	**10.00%**	1.10%
	2	1

The results in Table 24 indicate that the impact on profitability of implementing the various sustainable manufacturing initiatives is not directly related to carbon emissions, and that the LPG saving will have a bigger impact on profitability but a lower impact on the sustainability of the business.

4.2.5 Case study: *Deliver*

The *deliver* case study includes modelling the current impact of market trends and GSCM ideas in a central distribution warehouse to understand the environmental and financial impact before considering the implementation of the initiatives. The CDC in Johannesburg is the largest of the case study company's CDCs in South Africa, and is regarded as the main CDC. It is thus the focus of the *deliver* case study. The data-gathering process includes searching for the latest market trends in greening warehouses and related activities, using case studies from companies in the FMCG industry as a base. Other data sources include the cost of running the warehouse for the previous year, the cost of implementing some of the ideas, and any other relevant cost data that is required. The current CDC only contributes a total of 3.3 per cent to the total plant electricity bill, whereas most of the electricity is consumed by the plant. The distribution centre needs to operate 24 hours a day, seven days a week, and needs high levels of visibility to avoid accidents. To reduce the carbon emissions, two initiatives were identified and investigated: daylight harvesting, and replacing the current lighting with fluorescent lighting – T8 Fixtures (McComb 2013).

Daylight harvesting initiative

The daylight harvesting initiative includes investigating the use of motion and daylight sensors for the lights that are currently left on all day, so that they turn off when no daylight or motion is detected. The suggestion was also to install clear panels in the warehouse so that natural daylight could be used instead of all the lights (McComb 2013). Figure 87 summarises the investment in and saving from this initiative. The payback period is eight months, and it is easy to implement. The 35 000 kWh saving is equal to a saving of 16 175 $kgCO_2e$ and a reduction of 6 per cent in the total $kgCO_2e$. As before, the carbon emissions are calculated using the DEFRA (n.d.) carbon emissions conversions (Figure 84). The proposed saving of 35 000 kWh is multiplied by the factor of 0.46213 to yield 16 175 $kgCO_2e$.

Type	Recommendations	Investment	Saving	Estimated kWh savings	Payback period (years)	Ease of implementation (1 - easy, 3 - medium, 5 - hard)
Electrical Energy Recommendations	Turn lights off/ Daylight Harvesting	24 750	28 000	35 000	1	1
		24 750	**28 000**	**35 000**		

Electricity Usage

Activity	Country	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Electricity generated	Electricity: UK	kWh	2015	0.46213	0.45844	0.00035	0.00334

Total kWH saving	35 000	kWh
Converted to kgCO_2e	16 175	kgCO2e

Total kWH saving	35 000	kWh
Converted to kgCO_2e	16 175	kgCO2e

Electicity usage per annum CDC	549 600	kWh
Reduction as % of total consumption	6%	%

Figure 87: *Deliver* case study: Daylight savings initiative – carbon emission calculation

Fluorescent lighting initiative

The initiative to install fluorescent lighting T8 fixtures involves replacing the current fluorescent lighting with retrofits that can reduce the energy consumption per light. It involves replacing the starter of the existing fitting while retaining the fitting (McComb 2013). Figure 88 shows that the fluorescent lighting initiative requires an investment of R4 234 to yield a saving of R5 214. The payback period is eight months, and it is easy to implement. The 6 518 kWh saving is equal to a saving of 3 012 CO_2e and a reduction of 1 per cent in the total CO_2e. As before, the carbon emissions are calculated using the DEFRA (n.d.) emissions factors (Figure 85).

Type	Recommendations	Investment	Saving	Estimated kWh savings	Payback period (years)	Ease of implementation (1 - easy, 3 - medium, 5 - hard)
Electrical Energy Recommendations	Fluorescent Lighting – T8 Fixtures	4 234	5 214	6 518	1	1
		4 234	**5 214**	**6 518**		

Electricity Usage

Activity	Country	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Electricity generated	Electricity: UK	kWh	2015	0.46213	0.45844	0.00035	0.00334

Total kWH saving	6 518	kWh
Converted to $kgCO_2e$	3 012	kgCO2e

Electicity usage per annum CDC	549 600	kWh
Reduction as % of total consump	1%	%

Figure 88: Summary of the fluorescent lighting T8 fixtures initiative

4.2.5.1 Green Business Profitability Framework: *Deliver*

Daylight harvesting initiative

The daylight harvesting initiative saving of R28000 will decrease the warehouse cost and increase the GP2 by 0.001 per cent. The initiative will have a total impact of 0.001 per cent on business profitability and a carbon emission reduction of 6 per cent. Figure 89 gives the detail of the Green Business Profitability Framework calculation.

Fluorescent lighting initiative

Replacing the current lighting with fluorescent lighting decreases the warehouse cost by R5214 per annum, and this increases the GP by 0.0002 per cent. The initiative will increase total business profitability by 0.0002 per cent, and generate a carbon emissions reduction of 1 per cent. The calculation detail of the Green Business Profitability Framework is given in Figure 90.

As-Is Cost:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**

Deliver Daylight harvesting initiative:

With manufacturing, primary transportation and warehouse cost changes etc.:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 513 141	711 774 961	33%	148 063 921
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 306 461	77 690 114	32%	31 102 947
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 819 602**	**789 465 075**	**32%**	**179 166 868**

Storage cost saving	**28 000**
Difference in GP2	**0.001%**

Figure 89: *Deliver* case study: Daylight Harvesting Initiative – GP2 impact of 0.001 per cent

As-Is Cost:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**

Deliver Case Study Fluorescent lighting initiative

With manufacturing, primary transportation and warehouse cost changes etc.:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 534 569	711 753 532	33%	148 063 921
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 307 819	77 688 756	32%	31 102 947
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 842 388**	**789 442 289**	**32%**	**179 166 868**

Storage cost saving	**5 214**
Difference in GP2	**0.0002%**

Figure 90: *Deliver* case study: Fluorescent lighting initiative - GP2 impact of 0.0002 per cent

4.2.5.2 *Deliver* case study summary

Van Zyl (2010) states that the warehouse's functions are incorporated in SCOR, but with limited focus on its processes and sub-processes. The best practices for warehouse functions are not included in the GreenSCOR model, but the Green Business Profitability Framework has the capacity to quantify the green initiatives mentioned in the warehouse and to use the DEFRA (n.d.) factors to calculate the carbon emission factors.

Table 25 summarises the findings of the warehouse scenarios, and indicates that the impact on profitability is not directly related to carbon emissions. The daylight harvesting initiative has a bigger impact on carbon emission reduction, but produces a lower increase in business profitability than the fluorescent lighting initiative.

Table 25: *Deliver Case Study* – Results per annum

	Daylight harvesting	**Fluorescent Lighting – T8 Fixtures**
Cost of goods sold (COGS) decrease	0.001%	0.0002%
Business profitability increase (gross profit)	**0.001%**	0.0002%
Carbon Emission reduction %	**6.00%**	1.00%
	1	2

4.2.6 Case study: *Return*

The *return* case study focuses on reducing return loads and disposing of stale products at the different CDCs, instead of moving all the stale products back to the plant in Johannesburg. Figure 91 illustrates the geographical representation of the return load kilometres that could be reduced by changing the process of handling returned products.

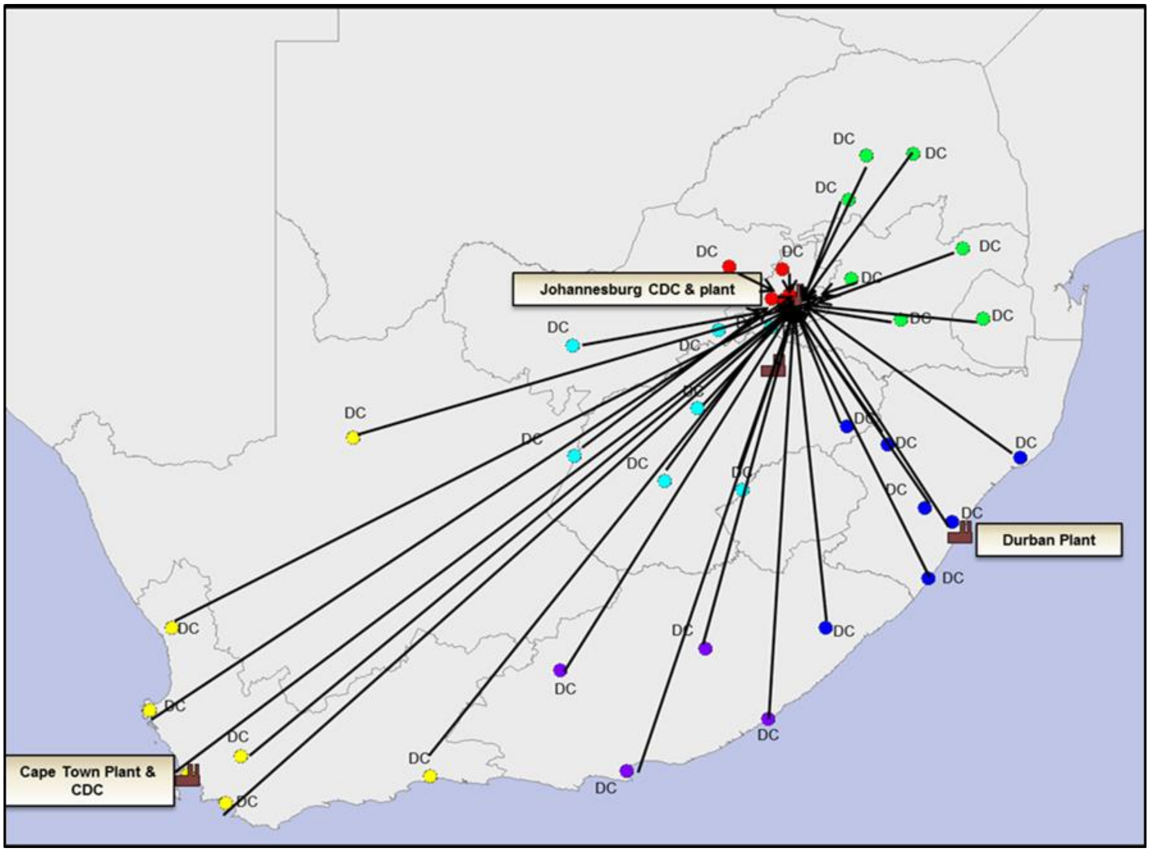


Figure 91: Return load – current geographical representation

The current kilometres travelled for return loads – from the Johannesburg plant (dispatching the truck) to the DCs and back with defective goods – are shown in Table 26. The distance travelled in one year, based on one delivery per week, totals 1 732 403 kilometres.

Table 26: Current return load distance travelled (kms)

	Kilometers per week	Kilometers per month	Kilometers per year
One trip per week per DC	36 092	144 367	1 732 403
Two trips per week per DC	72 183	288 734	3 464 806

The proposed solution is to return defective goods to the closest CDC. There are currently three CDCs: in Johannesburg, Cape Town, and Durban. Figure 92 illustrates the proposed solution of returning stale products to the closest CDC for destruction.

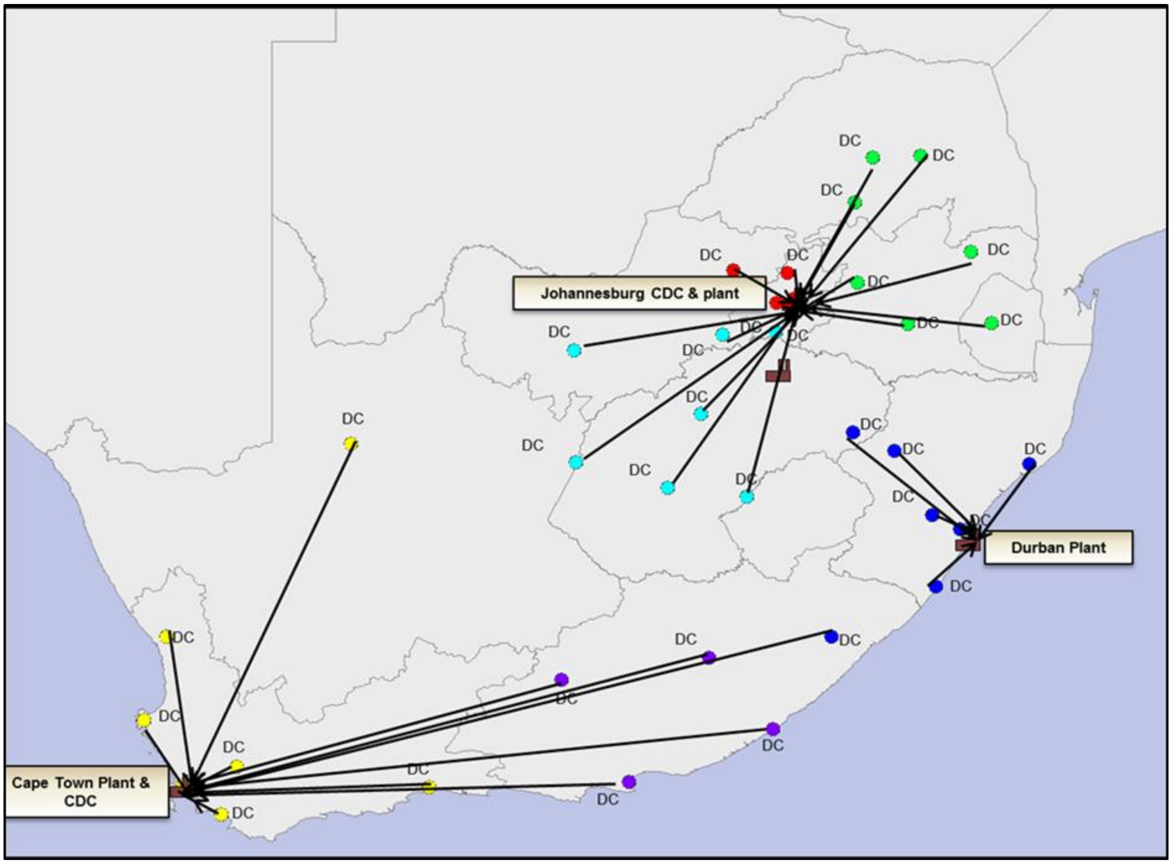


Figure 92: Suggested return load process – geographical representation

The kilometres travelled to each CDC from the various DCs are shown in Table 27.

Table 27: *Deliver* case study – scenario comparison

Isando	**Kilometers per week**	**Kilometers per month**	**Kilometers per year**
One trip per week per DC	8 996	35 983	431 795
Two trips per week per DC	17 991	71 966	863 591
Parow	**Kilometers per week**	**Kilometers per month**	**Kilometers per year**
One trip per week per DC	9 031	36 124	433 492
Two trips per week per DC	18 062	72 249	866 985
Pinetown	**Kilometers per week**	**Kilometers per month**	**Kilometers per year**
One trip per week per DC	2 335	9 339	112 071
Two trips per week per DC	4 670	18 679	224 142
Saving in kilometers	**Kilometers per week**	**Kilometers per month**	**Kilometers per year**
One trip per week per DC	15 730	62 920	755 044
Two trips per week per DC	31 460	125 841	1 510 089

The impact of the suggested change is a reduction of 44 per cent in the total return kilometres travelled from each DC. Table 28 gives the detail, with a total annual kilometre reduction of 755 044 km.

Table 28: Kilometres saved

Saving in kilometers	Kilometers per week	Kilometers per month	Kilometers per year
One trip per week per DC	15 730	62 920	755 044
Two trips per week per DC	31 460	125 841	1 510 089

	% Saving in kilometers
One trip per week per DC	44%
Two trips per week per DC	44%

The reduction in kilometres travelled has a direct influence on the number of litres of fuel used per year. The return loads are seen as part of primary distribution, and the loads are outsourced to a logistics provider that charges a lane rate, made up of fuel, repairs, maintenance, and overheads. The reduction in kilometres will reduce the carbon emission generated. To access the total impact on business cost and profitability, the Green Business Profitability Framework is used to access the impact on the total supply chain, where the area impacted is the delivery costs before GP level 3.

The DEFRA (n.d.) carbon emissions factors are used to convert the reduction in kilometres to carbon emission impact. The annual 755 044 km reduction converts to a reduction in carbon emission of 189 tonnes. Table 29 gives the detail of the carbon emission calculation.

Table 29: Suggested return load geographical representation – carbon emissions and kilometre calculation detail

Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on one return trip per DC per week to the CDC)*	1 732 403
Kilometres travelled Proposed annually *(based on one return trip per DC per week to the CDC)*	977 359
Kilometres reduction annually	755 044
Current carbon emissions (tons) annually	433
Proposed carbon emissions (tons) annually	244
Carbon emission reduction (tons) annually	189
% Carbon emission reduction	**44%**

4.2.6.1 Green Business Profitability Framework – *Return*

Figure 93 illustrates the *return* case study, marked in red, using the SCOR model. The suggested best practice, *avoid returns beyond economic repair*, links to the process *DR1.1 Authorize Defective Product Return (carbon emissions)* and from there flows into *DR1.2 Schedule Defective Return Receipt emission*. This in turn links into the level 3 process *DR1 Deliver Return Defective Product (carbon emissions),* which flows into the level 2 process *return carbon emissions* and ends in the level 1 process *total supply chain carbon footprint.* In the *return* case study, the applicable metric for quantifying the impact of GSCM with the SCOR model is carbon emissions. According to SCC (n.d.)., the five metrics of the GreenSCOR model are measured for each level 3 process, and then combined to give the values of the level 1 and 2 processes. The *total supply chain carbon footprint* is equal to the sum of emissions from energy and fuel consumption and process-related emissions (SCC n.d.).

The reduction of 755 044 kilometres per annum improves business profitability by 0.04 per cent at the GP3 level, owing to the reduced primary distribution cost (Figure 94). The original business profitability and the impact of the *return* case study are illustrated in

Figures 95 and 96. The results indicate that the return load reduction initiative could reduce the cost, and so increase business profitability, by R977 606 per annum.

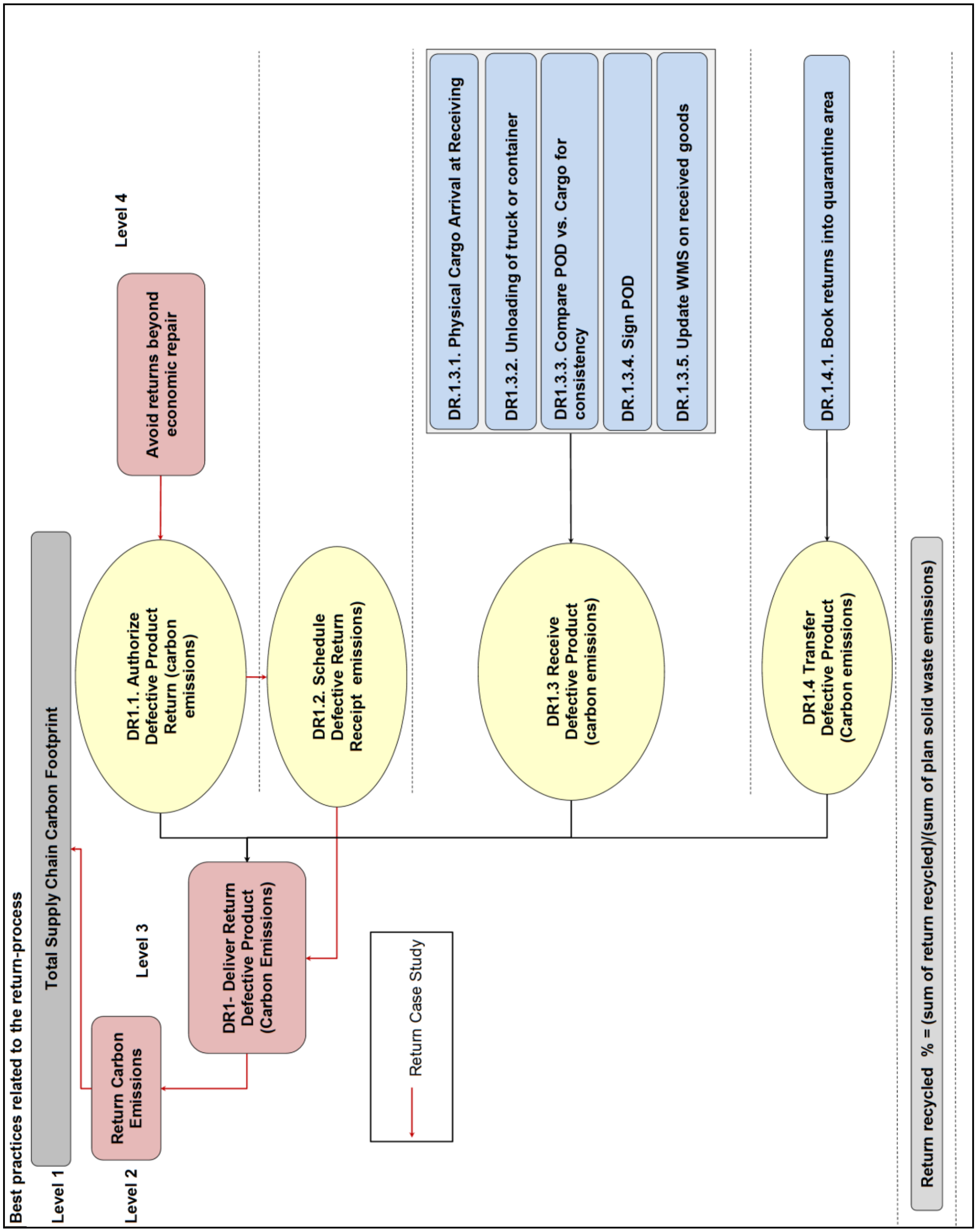


Figure 93: *Return* case study – Applying the SCOR model and best practices

As-Is Cost:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	148 063 921	563 684 708	25.76%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.91%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	37%	**105 847 602**	**789 437 075**	32%	**179 166 868**	**610 270 207**	25.07%

Return Scenario Modelling:

With return load reduction:

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37%	99 539 473	711 748 629	33%	147 086 315	564 662 314	25.81%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34%	6 308 129	77 688 446	32%	31 102 947	46 585 499	18.91%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**178 189 262**	**611 247 813**	**25.11%**

Difference in GP3	**0.04%**

Figure 94: *Return* case study – GP3 impact of 0.04 per cent

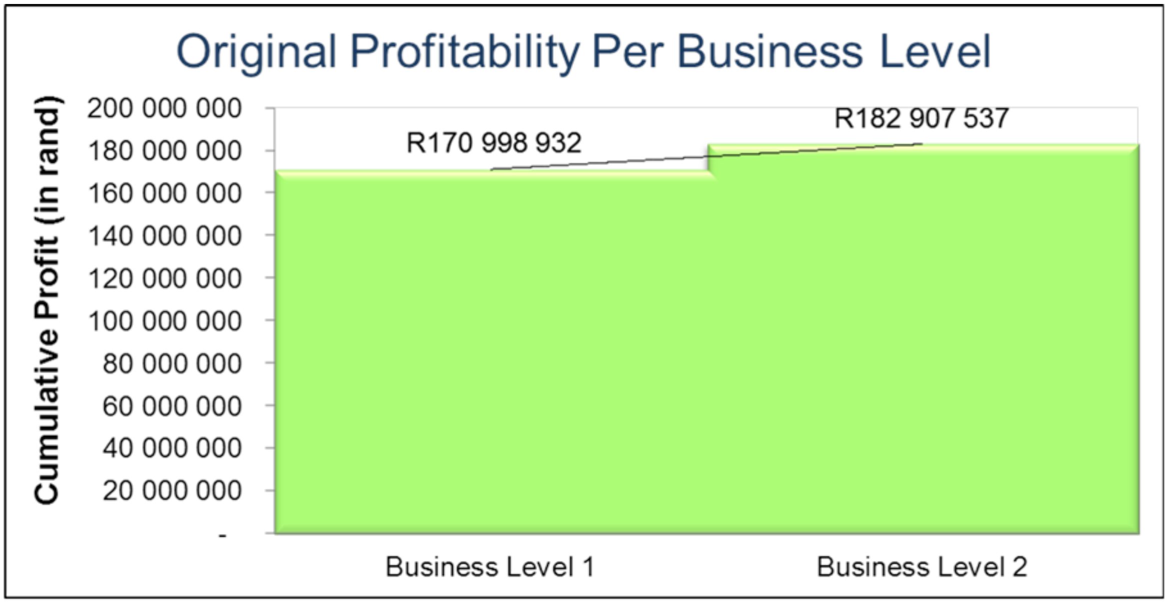


Figure 95: Original profitability per business level

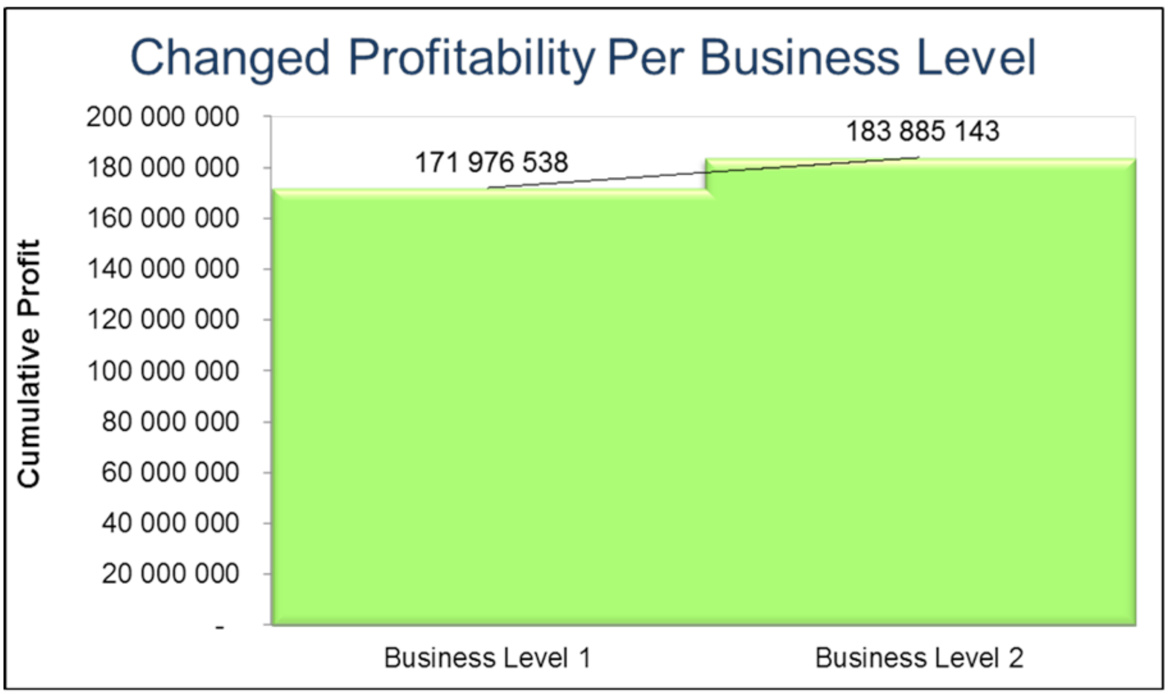


Figure 96: Changed profitability per business level

Applying the Green Business Profitability Framework quantifies the impact of the *return* initiative in both environmental and financial terms: a saving of R977 606 for 189 tonnes of carbon emission reduction. This enables green supply chain initiatives to be quantified in financial and environmental terms, and helps the company to motivate the implementation of the green initiative on the grounds of its financial benefits.

4.2.6.2 *Return* case study summary

Changing the current returns handling process will save a total of 189 tonnes of carbon emission. This will have an impact on the total supply chain carbon footprint. In this case study, the GreenSCOR model has provided the best practice link to detail the processes, in order to understand the root cause of the emissions. Using the DEFRA (n.d) carbon emission conversions, the saving in kilometres are converted into carbon emissions. The Green Business Profitability Framework is then used to determine the business profitability impact of the case study.

From the *return* case study, the proposed operational change will result in a 0.04 per cent increase in business profitability and a 44 per cent carbon emission reduction. The main driver for the carbon emission reduction is a reduction in the kilometres travelled back to the CDC; and in the proposed scenario, these kilometres will be eliminated. The results in Table 30 indicate that the impact on profitability is not directly related to carbon emissions: while carbon emissions will be reduced by 44 per cent, business profitability will increase by only 0.04 per cent. This shows that a greater reduction in carbon emissions has a minimal impact on business profitability.

Table 30: *Return* case study results per annum

	Scenario 1
Delivery cost decrease (primary transportation cost)	0.04%
Business profitability increase (gross profit)	**0.04%**
Carbon Emission reduction %	**44%**
	1

4.3 Framework implementation and integration

The Green Business Profitability Framework will be integrated into the business and its monthly reporting processes in future. At present the framework is implemented on multiple Microsoft Excel spreadsheets; the aim is to automate the framework.

This automation will be made possible by integrating the framework into the current enterprise resource planning (ERP) system, creating a central database with information that will update automatically, and to generate automatic monthly reports by using the latest business intelligence visualisation software, Qlikview. Qlikview can help to reduce the time for data collection, automate business reporting, combine data from different systems, and analyse multiple large sets of data. Qlikview is also available on a desktop computer, on a server, or in the Internet cloud (Qlikview n.d.).

Qlikview has already been applied successfully in businesses in the healthcare, financial services, retail, manufacturing, energy and utilities, communications, public, and consumer product sectors (Qlikview n.d.). Once the integration is complete, the software is able automatically to generate graphs and tables similar to those presented in the case studies.

4.4 Additional case study conclusions

Some additional conclusions from the case studies are summarised below.

- Not all optimisation initiatives will result in a carbon reduction initiative

- The *Source* case study concluded that the impact on profitability is not directly related to carbon emissions, and that optimising profitability and sustainability is a trade-off.

- The results of using the Green Business Profitability Framework to model a short-term strategic plan indicated that the reduction in kilometres travelled achieved by optimising the secondary transportation network was directly related to the amount of carbon emissions, but not to an increase in business profitability. In the case study, the net effect was a reduction in carbon emissions and an increase in business profitability; but it cannot be assumed that all of the DCs will show a carbon emission saving.

- The *Make* case study results indicated that the impact on profitability, as a result of implementing the various sustainable manufacturing initiatives, was directly related to carbon emissions. In addition, the LPG saving had a bigger impact on profitability – but a lower impact on sustainability – than did the electricity saving.

- The *Deliver* case study indicated that the impact on profitability was not directly related to carbon emissions. The daylight harvesting initiative had a bigger impact on the reduction of carbon emissions, but produced a lower increase in business profitability, than did the fluorescent lighting initiative.

- The *Return* case study showed that a greater reduction in carbon emissions can have only minimal impact on business profitability, depending on the initiative considered.

Chapter 5: Conclusions and Recommendations

Srivastava (2007) concluded that most of the research in Green Supply Chain Management (GSCM) and supply chain optimisation was conducted in different parts of the world, with limited interaction between researchers. In addition, most of the research is at a theoretical research level in papers and frameworks. Srivastava (2007) proposed a practical framework as the way forward for green supply chain research. This framework should be able to determine the optimal way for a company to select initiatives and products to maximise profitability, while keeping in mind the protection of brand integrity. Therefore, a combination of traditional and new techniques, and various frameworks, had to be achieved during the overall GSCM and design.

This research supports the need to quantify the impact of implementing green supply chain initiatives in a company on the profitability and sustainability of that company's supply chain. Existing methods, used to assess the business profitability and sustainability impacts of initiatives, do not focus on monitoring the complete supply chain, from operational activities to longer term strategic initiatives. And existing frameworks do not combine both components; they look at either profitability or sustainability, but not at both (Porter & Van der Linde 1999; Marchal *et al.* 2011; Schaefer & Kosansky 2008)

The Green Business Profitability Framework was developed to assist decision-makers to evaluate the financial and environmental impact of sustainability initiatives in a business. Decision-makers are thus helped to make strategic decisions to improve the business' environmental impact; and the business is helped to operate in a way to gain competitive advantage in its markets. The Green Business Profitability Framework considered and combined various aspects of the life cycle assessment (LCA) method, a value-added approach (VAA), supply chain operations reference model (SCOR) methodology, product costing, 'cost to serve', activity- based costing (ABC), business profitability, and the green supply chain operations reference model (GreenSCOR) methodology, and was used to quantify the financial and environmental effect of GSCM initiatives (Dawson consulting n.d.; Jooste & Van Niekerk 2009; Ernst & Young n.d.; Lessner 1991).

The framework was developed using earlier research, the application of other frameworks, and case studies. The developed framework was applied to a series of cases studies in different parts of the case study company's supply chain. Building the theory was the main part of the method, followed by testing it, and application research. Theory-building included the academic research; summarising it in an end-to-end supply chain matrix view; using the existing literature; highlighting which parts of the supply chain were addressed by existing frameworks; the specific industry focus of the case studies; and the applied research methodologies. The theory-testing and application research was done by applying the framework to multiple case studies at a single case study company. The baseline (actual) was compared with the different scenarios to understand the full impact of green supply chain initiatives.

These case studies were used to determine the impact on the environment and on profitability by implementing initiatives aimed at reducing greenhouse gas (GHG) emissions. The SCOR model's level 1 processes aided in the selection of the case studies, to ensure that different areas of the supply chain were addressed. Due to the sensitivity and confidentiality of the financial data, the framework was only applied to one

South African fast moving consumer goods (FMCG) company to determine whether the framework could be a suitable solution for quantifying GSCM in a business. Not all of the main role players in the FMCG industry in South Africa were analysed, therefore, and the study cannot be used to derive industry trends. However, it serves as a good starting point for similar studies in the future.

The case studies addressed different applications of optimisation initiatives, from short-term to longer-term strategic objectives. In the *Plan* case study, the framework was applied to determine whether it is a suitable application to solve short-term network planning queries. The *Source* case study focused on long-term strategy development, while the *Make* case study incorporated recommendations from a third party consultant. The *Deliver* case study focused on modelling the impact of the current internal initiatives and market trends, while the *Return* case study determined the impact of operational changes in the case study company.

The main objectives of the research study were to develop an analytical framework to quantify the impact of implementing environmentally-friendly initiatives on business profitability and sustainability, and then to apply the framework to an actual business. These objectives were achieved by developing the Green Business Profitability Framework and applying it to various case studies at a global, South African-based FMCG company. The case studies illustrated that the Green Business Profitability Framework can be applied successfully to inform short-term planning, inform long-term strategic planning, evaluate third party recommendations, evaluate current internal initiatives, and determine the impact of operational changes.

The results of the case studies indicated that the Green Business Profitability Framework enabled the tracking of environmental initiatives back to logistics operations and profitability. The developed framework also helped to link the carbon emissions to source, and to translate green supply chain actions into goals. Cash and Wilkerson (2003:6) found that GreenSCOR, which is part of the Green Business Profitability Framework, aids in green management by linking best practices to the detailed processes and, if applied, can assist in reducing carbon emissions. GreenSCOR can only quantify carbon emissions, and so it needs to be used in conjunction with other frameworks and costing methods to determine the profitability impact.

From the case studies it can be concluded that not all optimisation initiatives will result in carbon reductions. The *Plan* case study focused on the short-term strategic planning application, and concluded that the net effect was a reduction in carbon emissions and an increase in business profitability. The *Source* case study considered various sourcing options, concluding that the impact on profitability was not directly related to carbon emissions, and that optimising, in terms of profitability and sustainability, is a trade-off. In the *Make* case study, the conclusion was that the impact on profitability from implementing various sustainable manufacturing initiatives was directly related to carbon emissions. The *Deliver* case study indicated that the impact on profitability was not directly related to carbon emissions. The *Return* case study showed that a greater reduction in carbon emissions has only a minimal impact on business profitability.

The scope of the study was limited to one South African FMCG company, to allow this company to be studied in some depth, and to determine whether the framework could be a suitable solution for quantifying GSCM in a business. Thus not all the main role players in the FMCG industry in South Africa were analysed; and the study should not be used to derive industry trends. However, it serves as a good starting point for similar studies in the future.

Ideas for future work that addresses some of the limitations of the framework might include implementing the Green Business Profitability Framework at other FMCG companies, and extending the study to other industries. At present, the framework is implemented on multiple Microsoft Excel spreadsheets, but the application of the framework could also be automated in future using Qlikview and other business intelligence software to make it easier and more user-friendly to update. This project will be undertaken in the case study company in the following year, after the conclusion of this study; due to the capital investment required for the programme, it could not be undertaken before the case study had been completed.

As South African businesses move from basic to optimised supply chains under current economic pressure, they will need to look again at all possible ways to reduce costs. With carbon tax legislation looming, businesses need to be smarter about implementing sustainability initiatives that make financial sense. The Green Business Profitability Framework presented here is a possible tool to determine the profitability and sustainability impacts of green initiatives. The results could also enable businesses to investigate the trade-offs between profitability and sustainability, so that they can make more informed decisions.

The researcher's contribution to the scientific knowledge base is in the form of an analytical framework that can enable FMCG companies to evaluate and quantify the financial and sustainable impact of their green initiatives. The project can also serve as the basis for future research in other projects that evaluate the financial and sustainable impact of environmentally-friendly initiatives. To the author's knowledge, this will be the first end-to-end Green Supply Chain case study in South Africa that analyses the impact on both profitability and sustainability.

6. References

Averkamp, H., 2015, 'Accounting Coach', viewed 21 June 2015, from http://www.accountingcoach.com/blog/calculate-payback-period.

Azevedo, S.G., Carvalho, H. & Cruz Machado, V., 2011, 'The influence of green practices on supply chain performance: A case study approach', *Transportation Research Part E,* 47, 850-871.

Azfar, K.R.W., Khan, N. & Gabriel, H.F., 2014, 'Performance measurement: A conceptual framework for supply chain practices', *Procedia-Social and Behavioural Sciences*,150, 803-812.

Barari, S., Agarwal, G., Zhang, W.J., Mahanty, B. & Tiwari, M.K., 2012, 'A decision framework for the analysis of green supply chain contracts: An evolutionary game approach', *Expert Systems with Applications*, 39, 2965-2976.

Beamon, B.M., 1999, 'Designing the green supply chain', *Journal of Logistics Information Management*, 12(4), 332-342.

Black, J.T. & Phillips, D.T., 2010, 'The lean to green evolution: A brief history of industrial engineering and what it means for the future', *Industrial Engineer*, 42, 6.

Bose, I. & Pal, R., 2012, 'Do green supply chain management initiatives impact stock prices of firms?', *Decision Support Systems*, 52, 624-634.

Brezet, J.,1995, *Product development with the environment as innovation strategy: The PROMISE Approach*, Faculty of Industrial Design Engineering, Section for Environmental Sciences, Netherlands.

Brown, J., 2013, 'Going green to save green', *Inbound Logistics*, viewed 18 January 2015 at http://www.inboundlogistics.com/cms/article/going-green-to-save-green/.

Capusneanu, S., 2008, 'Implementation opportunities of green accounting for activity-based costing (ABC) in Romania', *Journal of Theoretical and Applied Economics*,1, 57-62.

Cash, R. & Wilkerson, T., 2003, *GreenSCOR: Developing a green supply chain analytical tool*, Washington: LMI Consulting.

Chaabane, A., Ramudhin, A. & Paquet. M., 2012, 'Design of sustainable supply chains under the emission trading scheme', *International Journal of Production Economics*, 35, 37-49.

Charnay, J., Hoppe, J. & Wen-Hsu, C., 2008, 'Green cost management: Strategic measure, evaluation and control', viewed 17 October 2010 at http://www.thehoppeadvantage.com/docs/ACCT601-BMW-Paper-Green-Cost-Management.pdf.

Chowdhury, A.A. & Hamid, K.,2013. 'Present status of corporate environmental accounting (CEA) in Bangladesh: A study based on some selected textile companies', *Research Journal of Finance and Accounting* 4(17), 122-129.

Clift, R. & Wright, L., 2000, 'Relationships between environmental impacts and added value along the supply chain', *Journal of Technological Forecasting and Social Change* 65, 281-295.

Coad, E., 2014, World first report reveals the environmental impact of the consumer goods industry's use of plastics is $75 billion US 2014, *Businesswire.com,* viewed 9 June 2015, from http://www.businesswire.com/news/home/20140623006202/en/World-Report-Reveals-Environmental-Impact-Consumer-Goods#.VXbSKGkw_VU.

Dawson Consulting n.d., Overview of Dawson's 'Cost To Serve' Methodology, viewed 10 January 2015 at http://www.dawsonconsultinggroup.com/.

De Beer, P. & Friend, F., 2006, 'Environmental accounting: A management tool for enhancing corporate environmental and economic performance', Environmental Engineering Group, Department of Chemical Engineering, University of Pretoria.

De Bruijn, H., Van Duin, R. & Huijbregts, M.A.J., 2004, 'Life cycle assessment operational guide to the ISO standards', *Eco-efficiency in industry and science*, New York: Kluwer Academic Publishers.

DEFRA [Department of Environment, Food, and Rural Affairs], n.d., *Carbon emissions factors*, viewed 20 May 2015 at http://www.ukconversionfactorscarbonsmart.co.uk/.

Dües, C.M., Tan, K.H. & Lim, M., 2013, 'Green as the new Lean: How to use Lean practices as a catalyst to greening your supply chain', *Journal of Cleaner Production* 40, 93-100.

Du Toit, B.J., 2011, 'The effects of eco-labelling on consumer behaviour in the non-foods fast moving consumer goods category: A study of South African consumers', Masters of Business Administration Thesis, Stellenbosch: University of Stellenbosch.

Ellis, B.A., 2007, 'Life cycle cost', viewed 2 January 2015 at http://www.jethroproject.com/Life%20Cycle%20Cost1-3.pdf.

EPA [U.S. Environmental Protection Agency], n.d., Environmental management methods, viewed 21 September 2015 at https://www3.epa.gov/.

Ernst & Young, n.d., 2011, *Making the right connections*, viewed 4 January 2015 at http://www.ey.com/Publication/vwLUAssets/Talking_point__Making_the_right_connecti ns/$FILE/Talking%20point%20-%20Making%20the%20right%20connections.pdf.

EUISSCA [Electric Utility Industry Sustainable Supply Chain Alliance], n.d., viewed 11 October 2010 at http://www.euissca.org/documents/Environmental-Voluntary-Standards.pdf.

Evans, J.R., 2008, *Quality and performance excellence management, organization and strategy*, viewed 5 April 2015 at http://www.amazon.com/Quality-Performance-Excellence-James-Evans/dp/1133955932.

Fouché, D., 2012, 'South African retail and consumer products outlook 2012-2016', viewed 5 April 2015, from http://www.pwc.co.za/en_ZA/za/assets/pdf/retail-and-consumer-products-outlook-2012-2016.pdf.

Freeman, B., Haasz, S., Lizzola, S. & Seiersen, N., 2000, 'Managing your cost to serve', *Supply Chain Forum* 1, 8-28.

Friedman, T.L., 2008, *Hot, flat, and crowded: Why the world needs a green revolution – and how we can renew our global future*, Amazon.com, viewed 20 January 2014, from http://www.amazon.com/Hot-Flat-Crowded-2-0-Revolution-ebook/dp/B002VOGQQU.

Frost & Sullivan, 2015, 'Embracing change for a sustainable future', in Supply Chain Foresight 2015, viewed 11 October 2015, from http://www.barloworld-logistics.com.

Gilder, A., Parker, M. & Rumble, O., 2016, 'Reversing climate change starts at home: The South African carbon tax and the Paris Agreement', in the Carbon Tax Ensight, viewed 4 May 2016, from https://www.ensafrica.com/news/reversing-climate-change-starts-at-home-the-South-African-carbon-tax-and-the-Pa?Id=2175&STitle=carbon%20tax%20ENSight.

Gillmore, D., 2010, 'Supply Chain', in *Supply Chain Digest*, viewed 10 October 2010 at http://www.scdigest.com/.

Greve, N., 2015, 'Carbon tax postponed to 2016', *Engineering News*, viewed 15 November 2015, from http://www.engineeringnews.co.za/article/carbon-tax-postponed-to-2016-2014-02-26.

Gulsecen, S. & Kubat, A., 2006, 'Teaching ICT to teacher candidates using PBL: A qualitative and quantitative evaluation', *Educational Technology & Society* 9(2), 96.

Gupta, S.M. & Wang, H.F., 2011, *Green supply chain management: Product life cycle approach*, New York: McGraw-Hill.

Hervani, A.A., Helms, M.M. & Sarkis, J., 2005, 'Performance measurement for green supply chain management', *Benchmarking: An International Journal*, 12(4), 330-353.

Hilton, R.W., 1991, *Managerial accounting.* New York: McGraw-Hill.

Holden, L., 2007, 'The green supply chain: An overview', *Journal of Innovation & Entrepreneurship*, 1, 1-10.

I2 Technologies, computer software, Supply Chain Strategist version 6.3 Getting Started, viewed 14 June 2016 from https://www.jda.com/.

International Monetary Fund, n.d., *Regional Economic Outlook: Sub-Saharan Africa Navigating Headwinds April 2015*, viewed 11 October 2015 at http://imf.org.

Investopedia, n.d., *FMCG*, viewed 5 April 2011, from http://www.investopedia.com/terms/f/fastmoving-consumer-goods-fmcg.asp.

Isberg, S.C., 2012, 'Financial analysis with the Du Pont Ratio: A useful compass', viewed 26 April 2015 at http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCEQFjAA&url=http%3A%2F%2Fhome.ubalt.edu%2Fntsbisbe%2Ffin640%2Ffinancial_analysis_with_the_dupont_ratio.doc&ei=9kVsVe3uF8zjU4K0g8AF&usg=AFQjCNG06Wgks0qdPp_G_F3VyrNfNhcKqw&bvm=bv.94455598,d.ZGU

ISO [International Organisation for Standardization], n.d., Environmental management methods, viewed October 2015 at http://www.iso.org/iso/home.html.

Jain, V.K. & Sharma, S., 2014, 'Drivers affecting the green supply chain management adaptation: A review', *The IUP Journal of Operations Management,* 8(1), 52-63.

JDA, n.d. *JDA Software: Powering the Adaptive Supply Chain with Network Design and Optimization*, viewed 15 October 2015, from: http://www.jda.com/view/scm-brochure/Network-Design-Optimization-Solutions/.

Jooste, M. & Van Niekerk, H., 2009, 'Why consider 'cost to serve' modelling?', paper presented at the Sapics 31st Annual Conference, Sun City, South Africa.

Kaplan, R.S., 2010, 'Conceptual foundations of the balanced scorecard', Harvard Business School, viewed 29 April 2015 at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1562586.

Khoo, H.H., Bainbridge, I., Spedding, T.A. & Taplin, D.M.R., 2001, 'Creating a green supply chain', viewed 23 November 2014 at http://airccse.org/journal/mvsc/papers/3412ijmvsc05.pdf.

KPMG, n.d., *State of logistics survey explores trends in SA Supply Chains*, viewed 4 May 2016, from http://www.sablog.kpmg.co.za/2015/04/state-logistics-survey-explores-trends-sa-supply-chains/.

Kumar, D., 2013. 'CSIR 2013 10th State of Logistics Survey', *The CSIR*, viewed 10 January 2015 at http://www.csir.co.za/sol/.

Kumar, S., Teichman, S. & Timpernage, I.T., 2011, 'A green supply chain is a requirement for profitability', *International Journal of Production Research* 50(5), 1278-1296.

Kumo, W.L., Omilola, B. & Minsat, A., 2015, *African economic outlook 2015*, viewed 11 October 2015, from http://www.african economic outlook.org.

Lee, K., 2011, 'Integrating carbon footprint into supply chain management: The case of Hyundai Motor Company (HMC) in the automobile industry Ki-Hoon', *Journal of Cleaner Production* 19, 1216-1223.

Lee, K. & Cheong, I., 2011, 'Measuring a carbon footprint and environmental practices: The case of Hyundai Motors Co. (HMC)', *Journal of Industrial and Data Systems*,111, 961-978.

Lessner, J.A., 1991, 'Traps to avoid in product costing', *Journal of Accountancy* 172, 87.

Liedtke, C., 1994, 'MIPS', Resource management and sustainable development: Conference on the recycling of metals, Amsterdam, 19-21 October.

Lin, R., 2011, 'Using fuzzy DEMATEL to evaluate the green supply chain management practices', *Journal of Cleaner Production*, 1-8.

Magerholm Fet, A., 2002, 'Environmental management tools and their application – a review with references to case studies', viewed 1 February 2015 at http://www.iot.ntnu.no/users/fet/Publi-Forfatterskap/publikasjoner/Lisboa.pdf.

Marchal, V., Dellink, R., Van Vuuren, D., Clapp, C., Chateau, J., Lanzi, E., Magne, B. & Van Vliet, J., 2011, 'Organisation of economic co-operation and development gross domestic product', viewed 23 September 2011 at http://www.oecd.org/home/0,2987,en_2649_201185_1_1_1_1_1,00.html.

McComb, D., 2013, SME Energy Assessment, National Cleaner Production Centre, South Africa (NCPC).

Miles, K., 2014, 'KPMG Sector Report Fast-Moving Consumer Goods in Africa', KPMG, viewed 6 April 2015, from http://www.kpmg.com/Africa/en/IssuesAndInsights/Articles-Publications/General-Industries-Publications/Documents/Fast-moving%20Consumer%20Goods%20in%20Africa.pdf.

Murby, L. & Gould, S., 2005, 'Effective performance management with the balanced scorecard', viewed 29 April 2015, at http://www.cimaglobal.com/Documents/ImportedDocuments/Tech_rept_Effective_Performance_Mgt_with_Balanced_Scd_July_2005.pdf.

Mutingi, M., Mapfaira, H. & Monageng, R., 2014, 'Developing performance management systems for the green supply chain', *Journal of remanufacturing* 4(6), 1-20.

Norek, C.D. & Pohlen, T.L., 2001, 'Cost knowledge: A foundation for improving supply chain relationships', *International Journal of Logistics Management* 12, 37.

Olugu, E.U., Wong, K.Y., & Shaharoun, A.M., 2011, 'Development of key performance measures for the automobile green supply chain', *Resources, Conservation and Recycling,* 55, 567-579.

O'Reily, J., 2013, 'Green logistics the Walmart way', *Inbound Logistics*, viewed 18 January 2015 at http://www.inboundlogistics.com/cms/article/green-logistics-the-walmart-way/.

Porter, M.E. & Van der Linde, C., 1999, 'Green and competitive: Ending the stalemate', *Journal of Business Administration,* 1, 215-229.

PWC & Apics, 2013, Sustainable supply chains: Making value the priority, viewed 1 February 2015 at http://www.apics.org/docs/default-source/careers-development/final_pwc-whitepaper_web.pdf?sfvrsn=4.

Qlikview, n.d. Qlikview application, viewed 10 January 2016, from http://www.qlikview.co.za/?m=1.

Rao, P. & Holt, D., 2005, 'Do green supply chains lead to competitiveness and economic performance?', *International Journal of Operations and Production Management*, 25(9), 898-916.

Sarkis, J., 2002, 'A strategic decision framework for green supply chain management', *Journal of Cleaner Production* 11, 397-409.

SCC [The Supply Chain Council], n.d., *SCOR*, viewed 1 February 2015 at http://www.apics.org/sites/apics-supply-chain-council/frameworks/scor.

SCC The Supply Chain Council] n.d., *SCOR Revision 11,* viewed 7 April 2015 at http://www.apics.org/sites/apics-supply-chain-council/frameworks/scor.

Schaefer, T. & Kosansky, A., 2008, 'Can you be green and profitable?', in *Supply Chain Quarterly* Third Edition, viewed 16 January 2015 at www. supplychainquarterly.com.

Schoeman, C. & Sanchez, V.R., 2009, 'Green supply chain overview and a South African case study', paper presented at the 28th Annual Southern Transport Conference, CSIR & Cardiff University Case Study, South Africa, 6-9th July.

Sehgal, V., 2009, *Enterprise supply chain management, Integrating best-in-class processes,* New York: John Wiley and Sons.

Seuring, S., 2008, 'Assessing the rigor of case study research in SCM', *Supply Chain Management: An International Journal*, 13(2), 128-137.

Seuring, S. & Muller, M., 2008, 'From a literature review to a conceptual framework for sustainable supply chain management', *Journal of Cleaner Production* 16, 1699-1710.

Soltanali, S., Hagani, S. & Yaftabadi, P., 2008, 'Economic evaluation for air pollution control technologies selection in power plants processes', *International Journal for Environmental Science and Technology* 5(4), 555-564.

Srivastava, S.K., 2007, 'Green supply chain management: A state of the art literature review', *International Journal of Management Reviews* 9, 53-60.

Statista, n.d., *FMCG*, viewed 5 April 2011, from http://www.statista.com/statistics/260963/leading-fmcg-companies-worldwide-based-on-sales/.

Statistics South Africa, n.d., *Retail trade sales in South Africa 2014*, viewed 11 October 2015, from http://www.statssa.gov.za.

Stewart, G., 1997, 'Supply-chain operations reference model (SCOR): The first cross-industry framework for integrated supply chain management', *Logistics Information Management* 10(2), 62-67.

Sundarakani, B., De Souza, R., Goh, M., Wagner, S.M. & Manikandan, S., 2010, 'Modelling carbon footprints across the supply chain', *International Journal of Production Economics* 128, 43-50.

The Biofuels Academy, n.d., *Pyrolysis of Plastic*, viewed 10 June 2015, from http://biofuelsacademy.org/web-modules/process/pyrolysis/pyrolysis-of-plastic/

The Business Day Live, n.d., *SA's carbon tax 'delayed by one year' to 2016*, viewed 15 November 2015, from http://www.bdlive.co.za/national/science/2014/02/26/sas-carbon-tax-delayed-by-one-year-to-2016.

The Carbon Report, n.d., *The proposed South African carbon tax*, viewed 15 November 2015, from http://www.thecarbonreport.co.za/the-proposed-south-african-carbon-tax/.

The Economist and the International Monetary Fund, n.d., *World's top economies*, viewed 6 April 2015, from http://www.economist.com/topics/international-monetary-fund-imf.

The *Mail & Guardian*, 2012, *UN 12 April 2012*, media release 12 April 2012, viewed 29 April 2012, from http://mg.co.za/.

The United Nations, n.d., *Kyoto Protocol*, viewed 30 May 2015 at http://unfccc.int/kyoto_protocol/items/2830.php.

The US Department of Defense, n.d., Life Cycle Cost, viewed 21 September 2015 from http://www.defense.gov/.

The US Department of Energy, n.d., *Implementation framework*, viewed 30 May 2015 at http://www.google.co.za/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB0QFjAA&url=http%3A%2F%2Fwww.energy.gov%2F&ei=PQlqVYeZGu6s7AaCnYGABw&usg=AFQjCNEJhq1dxxfvnSku3qhhG7eHSMC0dw&sig2=kKkGVtDV29TXysLyFher0w.

Timme, S.G., 2005, 'The financial supply chain', Finlistics Solutions, CFO Project.

Tinjala, T., 2012, 'An effective tool for supply chain decision support during new product development process', PhD thesis, Dept. of Industrial Engineering and Management, University of Aalto.

Toke, L.K., Gupta, R.C. & Dandekar, M., 2010, 'Green supply chain management', in Critical Research and Practices – Proceedings of the 2010 International Conference on Industrial Engineering and Operations Management, Dhaka, Bangladesh, 9-10th January.

Tsai, W.H., Lin, T.W. & Chou, W.C., 2010, 'Integrating activity-based costing and environmental cost accounting systems: A case study', *International Journal of Business and Systems Research* 4(2), 186-280.

Ubeda, S., Arcelus, F.J. & Faulin, J., 2011, 'Green logistics at Eroski: A case study', *International Journal of Production Economics* 131, 44-51.

UNEP [The United Nations Environment Programme], n.d., *Cleaner Production*, viewed 12 April 2015 at http://unep.org/.

Van Hille, N. & Louw, G., 2012, 'Building a sustainable South African food retail sector August 2012', viewed 11 October 2015, from http://www.sustainalytics.com/sites/default/files/uploads/BuildingSustainableSAFoodRetailSector_August2012.pdf.

Van Hoek, R.I., 1999, 'From reversed logistics to green supply chains', *Journal of Supply Chain Management* 4,129-134.

Van Zyl, I.P., 2010, 'Developing a model for measuring the environmental performance of the Safcor Panalpina operations and third party logistics service provided to clients, with a further aim of developing a consultancy capability as a further service offering', Final Year Project, Department of Industrial Engineering, University of Pretoria.

Venture Lighting, n.d., *The Metal Halide Advantage*, viewed 28 June 2015, from http://www.venturelighting.com/techcenter/metal-halide-techintro.html

Walker, H., Di Sisto, L. & McBain, D., 2008, 'Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors', *Journal of Purchasing & Supply Management* 14, 69-85.

Wang, F., Lai, X. & Shi, N., 2011. 'A multi-objective optimization for green supply chain network design', *Decision Support Systems*, 51, 262-269.

Wilkerson, T., 2009, 'Introducing environmental considerations to the SCOR model', paper presented at the Supply Chain World 2008 North America Conference & Exposition, North America, 17-19th March.

Williams, A.S., 2009, 'Life cycle analysis: A step by step approach', viewed 20 April 2015 at http://www.istc.illinois.edu/info/library_docs/tr/tr40.pdf.

World Business Council of Sustainable Development, n.d., *Eco-efficiency*, viewed 10 October 2010 at http://www.wbcsd.org/home.aspx.

World Business Council for Sustainable Development and World Resources Institute, n.d., *Greenhouse gases*, viewed 11 June 2015, from http://www.wbcsd.org

Yin, R., 2014, *Case study research design and methods*, London

Zafar, S., 2015, Biomass Pyrolysis Process, viewed 9 July 2015, from http://www.bioenergyconsult.com/biomass-pyrolysis-process/

Zainal, Z., 2007, 'Case study as a research method', *Faculty of Management and Human Resource Development*, 9, 1-6.

7. Appendix A

7.1. SCOR *Plan* definitions

Process	Sub Process	Definition
P1		
Plan Supply Chain		Overall supply chain planning. The plan supply chain process will be the basis for plannning P2,P3,P4 and P5. (Also known in certain industries as budget and revenue plan)
	P.1.1	
	Identify, prioritize and aggregate supply chain requirements	The process of identifying, aggregating and prioritizing the product demand based on a forecast for a specific time period
	P.1.2	
	Identify, prioritize and aggregate supply chain resources	The process of identifying, aggregating and prioritizing the resource demand based on a forecast for a specific time period
	P.1.3	
	Balance supply chain resources with supply chain requirements	The process of identifying, aggregating and prioritizing the gap between the resources and required demand based on a forecast for a specific time period
	P.1.4	
	Establish and communicate supply chain plans	Establish and communicate the action plans to meet the required resource demands

Source: (Adapted from SCC n.d. and Van Zyl 2010)

Process	Sub Process	Definition
P2		Plan for material requirements for make (P3) and deliver (P4) activities.
Plan Source	**P.2.1**	
	Identify, prioritize, and aggregate product requirements	The process of identifying, prioritizing and aggregating all raw material requirements
	P.2.2	
	Identify, assess, and aggregate product resources	The process of identifying, assessing and aggregating all raw material resources that will be required
	P.2.3	
	Balance product resources with product requirements	The process of identifying, aggregating and prioritizing the gap between the raw material resources and required demand based on a forecast for a specific time period
	P.2.4	
	Establish Sourcing Plans	Establish and communicate the action plans to meet the required raw material demand

Source: (Adapted from SCC n.d. and Van Zyl 2010)

Process	Sub Process	Definition
P3		Plan the production resources required for manufacturing to meet required demand
Plan Make	**P.3.1**	
	Identify, prioritize, and aggregate production requirements	The process of identifying, prioritizing and aggregating all production requirements
	P.3.2	
	Identify, assess, and aggregate production resources	The process of identifying, assessing and aggregating all production resources that will be required
	P.3.3.	
	Balance production resources with production requirements	The process of identifying, aggregating and prioritizing the gap between the production resources and required demand based on a forecast for a specific time period
	P.3.4	
	Establish production Plans	Establish and communicate the action plans to meet the required production resource demand

Source: (Adapted from SCC n.d. and Van Zyl 2010)

Process	Sub Process	Definition
P4		Plan for handling and transporation of goods
Plan Deliver	**P.4.1**	
	Identify, prioritize, and aggregate delivery requirements	The process of identifying, prioritizing and aggregating all delivery requirements
	P.4.2	
	Identify, assess, and aggregate delivery resources	The process of identifying, assessing and aggregating all delivery resources that will be required
	P.4.3	
	Balance delivery resources with delivery requirements	The process of identifying, aggregating and prioritizing the gap between the delivery resources and required demand based on a forecast for a specific time period
	P.4.4	
	Establish Delivery Plans	Establish and communicate the action plans to meet the required delivery resource demand

Source: (Adapted from SCC n.d. and Van Zyl 2010)

Process	Sub Process	Definition
P5		Plan for reverse logistics if required
Plan Return	**P.5.1**	
	Identify, prioritize, and aggregate return requirements	The process of identifying, prioritizing and aggregating all return requirements
	P.5.2	
	Identify, assess, and aggregate return resources	The process of identifying, assessing and aggregating all return resources that will be required
	P.5.3	
	Balance return resources with return requirements	The process of identifying, aggregating and prioritizing the gap between the return resources and required demand based on a forecast for a specific time period
	P.5.4	
	Establish and communicate return plans	Establish and communicate the action plans to meet the required return resource demand

Source: (Adapted from SCC n.d. and Van Zyl 2010)

7.2. SCOR *Source* definitions

Process	Sub Process	Definition
S1 Source Stocked		Sourcing of raw materials, products, components and services based on the requirement
	S.1.1	
	Schedule Product Deliveries	Scheduling and managing the execution of individual product deliveries against an existing contract and purchase order
	S.1.2	
	Receive Product	Processes and activities associated with receiving goods on contract terms
	S.1.3	
	Verify Product	Verification process if products confirm to the standards and predetermined criteria
	S.1.4	
	Transfer Product	Transfer of the product for stock holding. Staging, transferring, handling and stocking product activities are also included.

Source: (Adapted from SCC n.d. and Van Zyl 2010)

7.2. SCOR *Make* definitions

Process	Sub Process	Definition
M1 Make to Stock		Making of the standard products, and the planning process determines what, how much and by when to make it.
	M.1.1	
	Schedule Production Activities	Scheduling and managing of the operations according to the production plans based on raw material availability
	M.1.2	
	Issue Product	Issuing of the raw material required for production and the activities involved to move the product from the raw material storage to the location in the plant where it is required
	M.1.3	
	Produce and Test	Production and testing of products to make sure the produced product fall into the required specification
	M.1.4	
	Package	Activities associated with packing of the product into boxes and from there onto pallets. The activities also include shrink wrapping, cleaning and sterilization
	M.1.5	
	Stage Product	Activities associated with moving the product to a temprorary holding location before it will be moved to the finished goods warehouse
	M.1.6	
	Release Product to Deliver	Activities associated with documentation generation etc. prior to delivering the finished products to the customer from the finished goods warehouse
	M.1.7	
	Waste Disposal	Activities associated with collection and management of waste during production and testing as well as the management of non conforming product

Source: (Adapted from SCC n.d. and Van Zyl 2010)

7.3. SCOR *Deliver* definitions

Process	Sub Process	Definition
D1		Finished goods product delivery to customers
Deliver Stocked Product	**D.1.1**	
	Process, Inquiry and Quote	Receive customer enquiry and quote
	D.1.2	
	Receive, Enter and Validate Order	Receive manual and electornic customer order
	D.1.3	
	Reserve Inventory and Determine Delivery Date	Reserve the inventory on the warehouse management system (WMS) and schedule the delivery
	D.1.4	
	Consolidate Orders	Consolidate the customer orders based on geographical location in order to minimize costs
	D.1.5	
	Build Loads	Truck load optimisation for the selected delivery

Source: (Adapted from SCC n.d. and Van Zyl 2010)

Process	Sub Process	Definition
D1		
Deliver Stocked Product	**D.1.6**	
	Route Shipments	Loads are consolidated and staged in the warehouse for a specific truck
	D.1.7	
	Select Carriers and Rate Shipments	Carriers tender for loads and loads are awarded on lowest cost basis
	D.1.8	
	Receive Product from Source or Make	Receive and check product from source or make to deliver to the customer
	D.1.9	
	Pick Product	Pick stored product on order by the customer
	D.1.10	
	Pack Product	Pack product in staging area in the warehouse

Source: (Adapted from SCC n.d. and Van Zyl 2010

Process	Sub Process	Definition
D1		
Deliver Stocked Product	**D.1.11**	
	Load vehicle and generate shipping documents	Load the vehicle with the product and generate the required shipping documentation
	D.1.12	
	Ship Product	The process of shipping the product to the customers
	D.1.13	
	Receive and Verify Product by Customer	The process of customer deliveyr and verification of order by the customer
	D.1.14	
	Install Product	The process to install the product if required
	D.1.15	
	Invoice	Generate final invoices and monthly statements and send it to the customer

Source: (Adapted from SCC n.d. and Van Zyl 2010

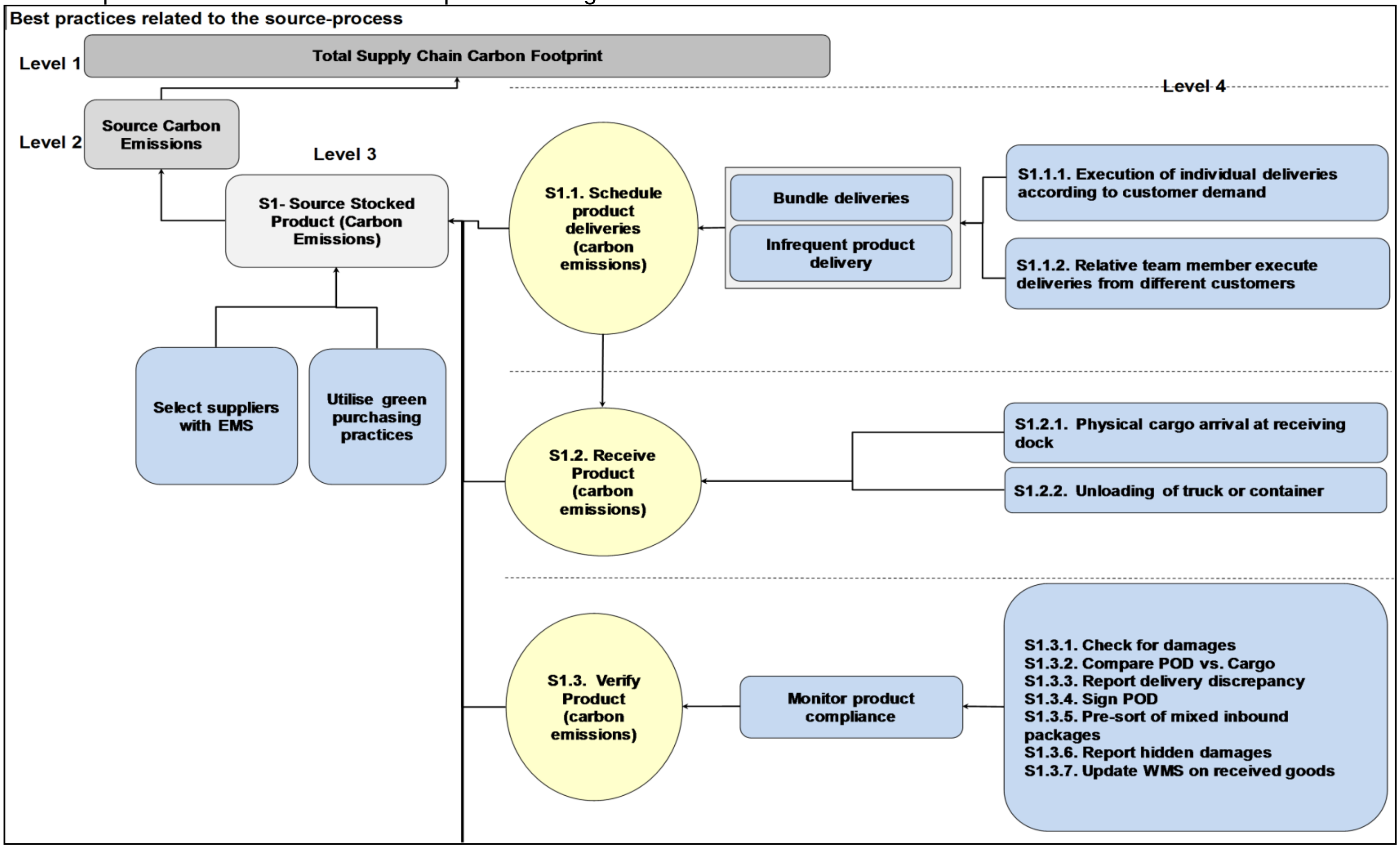
7.4. SCOR *Return* definitions

Process	Sub Process	Definition
DR1 Deliver Return Defective Product		The return of products because the product is damaged, old stock and the wrong product that was ordered or shipped
	DR.1.1	
	Authorize Defective Product Return	The process where the product return is authorized, and the customer contacted with a decision
	DR.1.2	
	Schedule Defective Return Receipt	The process where the product is returned to the suppliers
	DR.1.3	
	Receive Defective Product (includes verify)	The process where the defectivce product is received back into the warehouse and the required documentation are created
	DR.1.4	
	Transfer Defective Product	The retuned product is transferred to the approciate disposal location and the neccesary documentation created

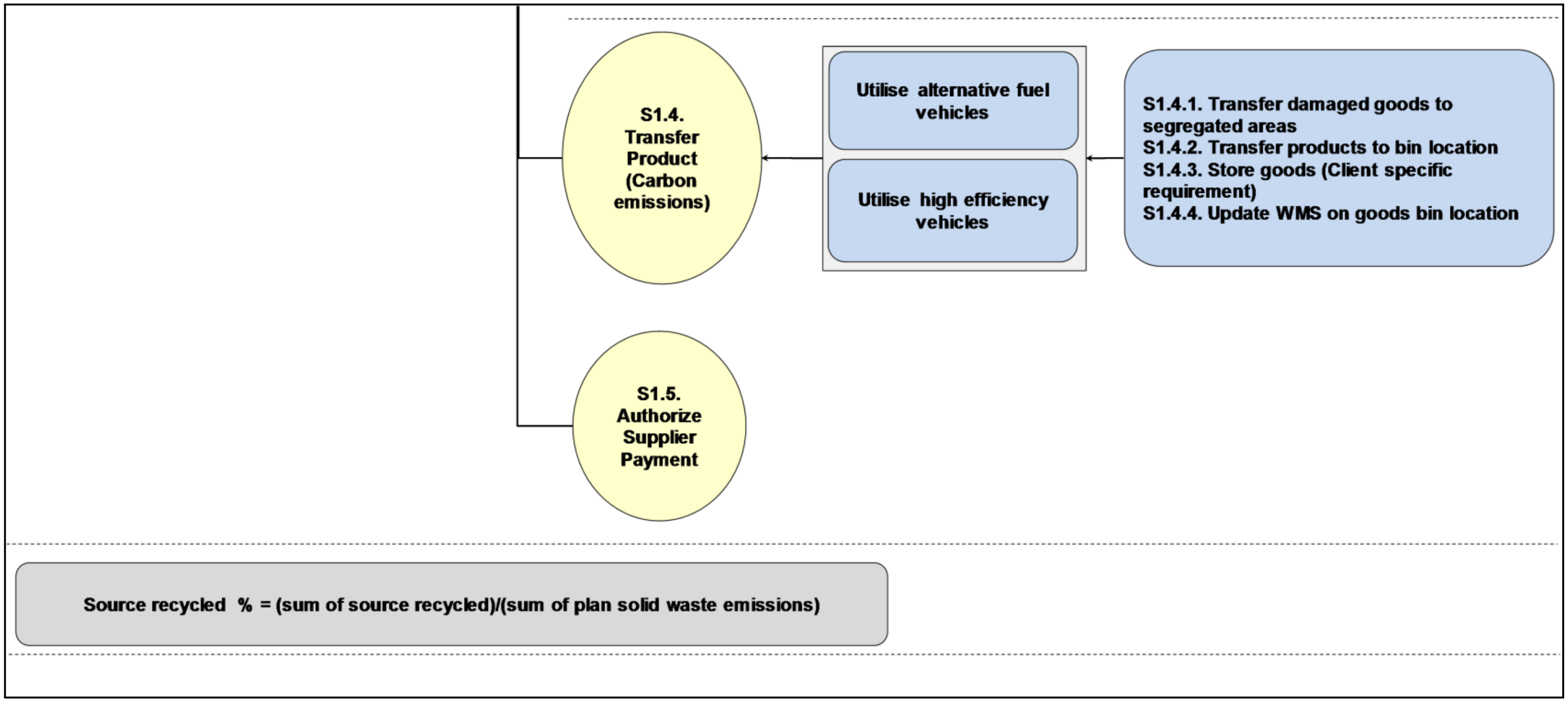
Source: (Adapted from SCC n.d. and Van Zyl 2010)

8. Appendix B

8.1 Best practices related to the *source* process using GreenSCOR

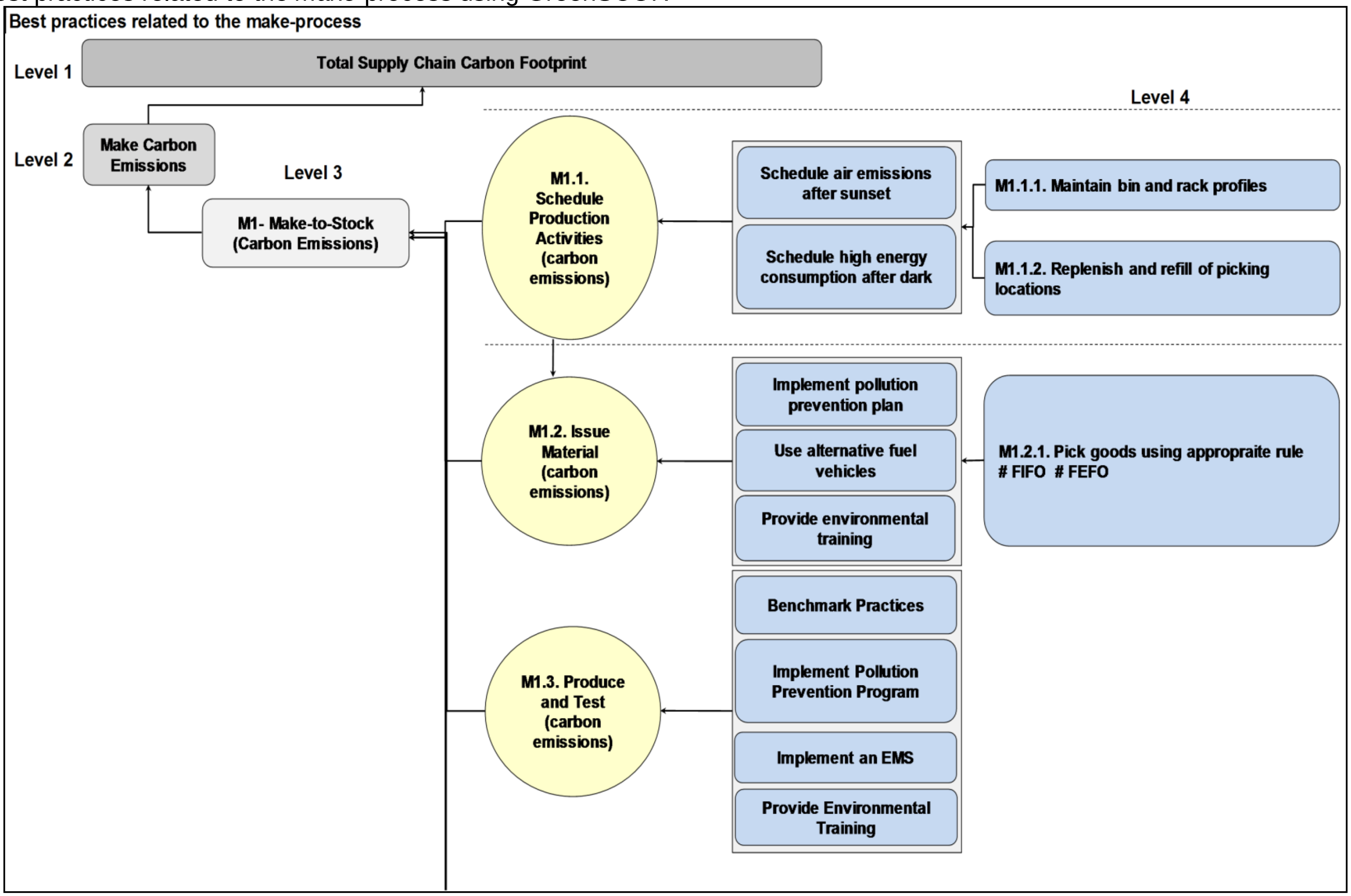


Source: (Adapted from SCC n.d. and Van Zyl 2010

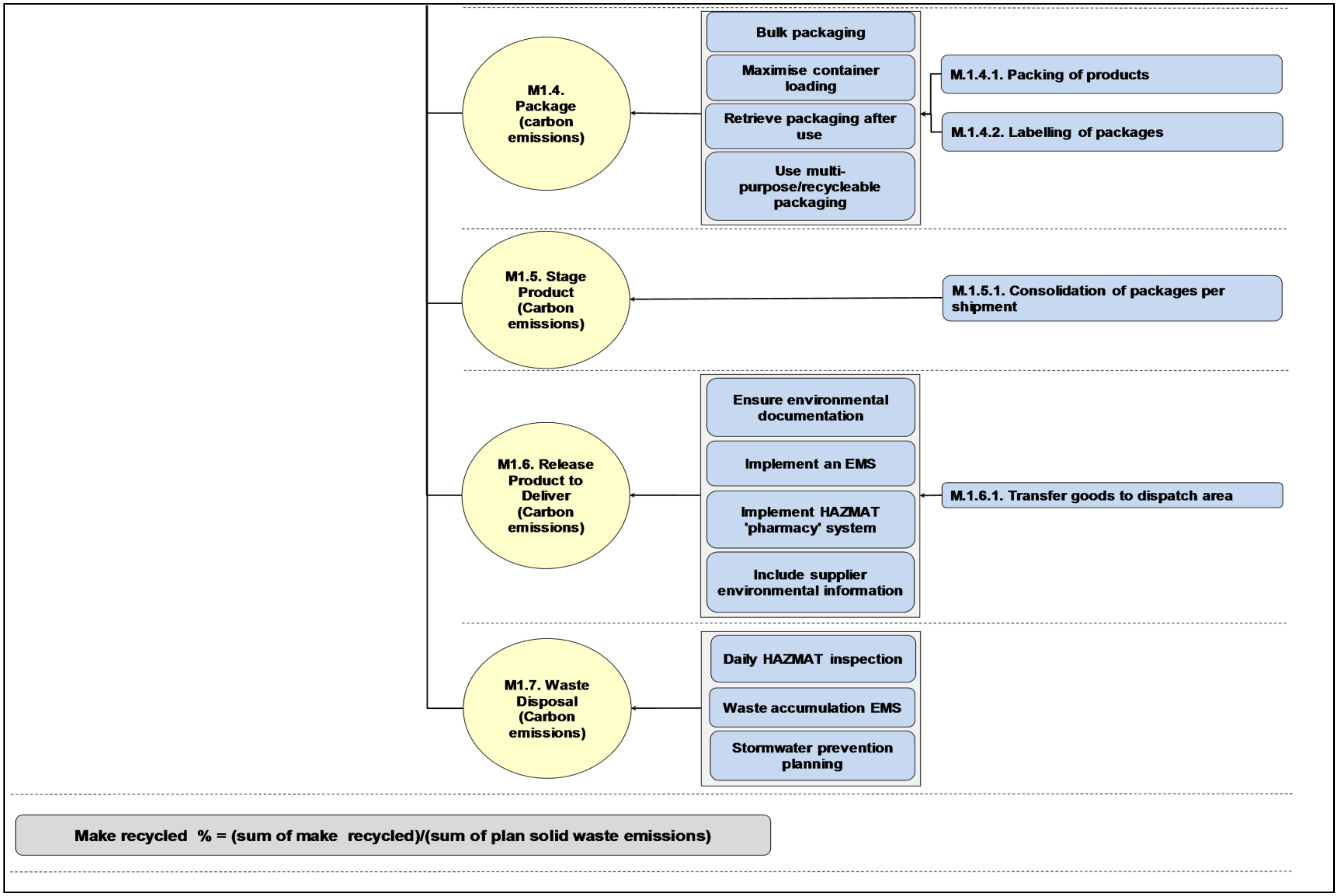


Source: (Adapted from SCC n.d. and Van Zyl 2010

8.2 Best practices related to the *make* process using GreenSCOR

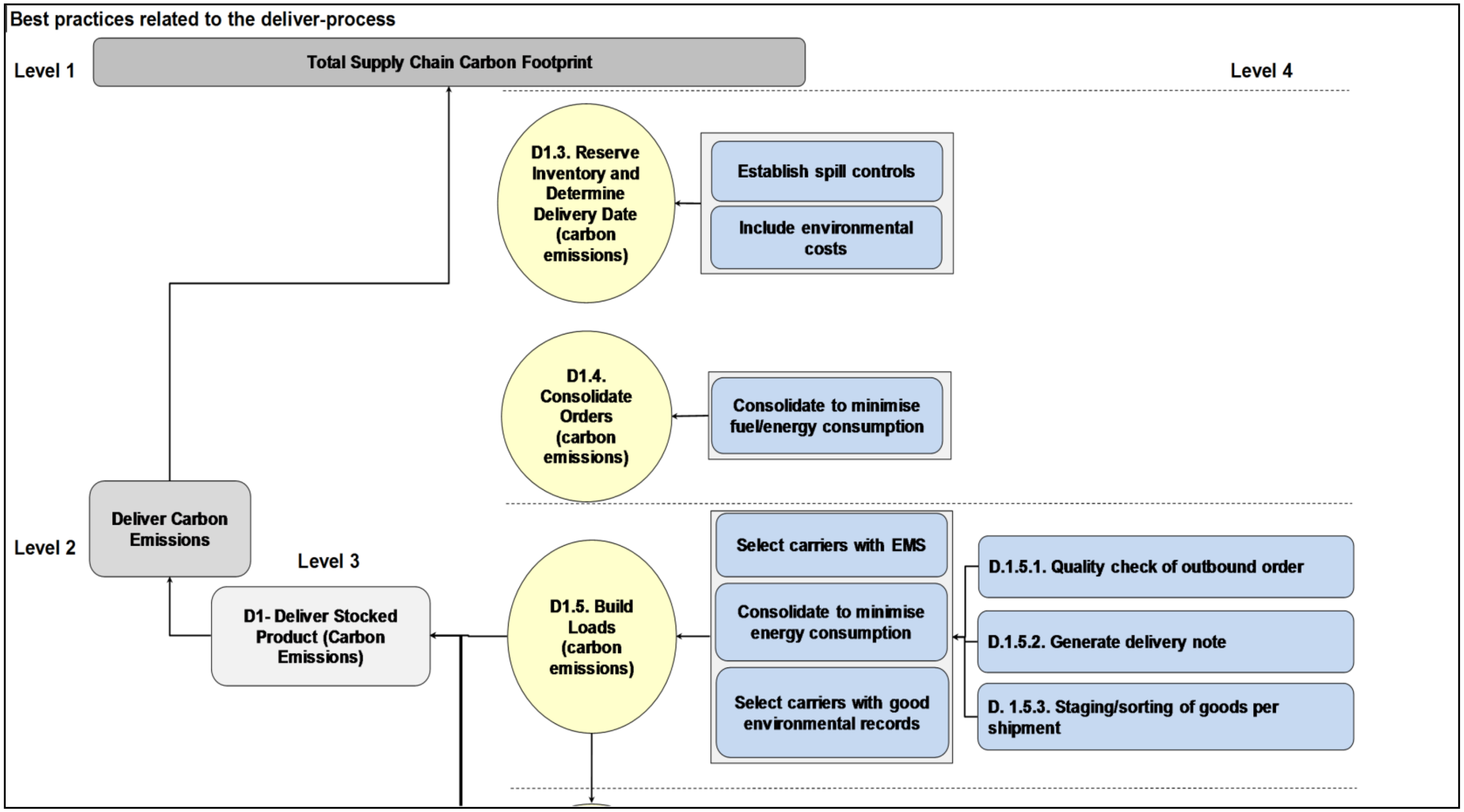


Source: (Adapted from SCC n.d. and Van Zyl 2010

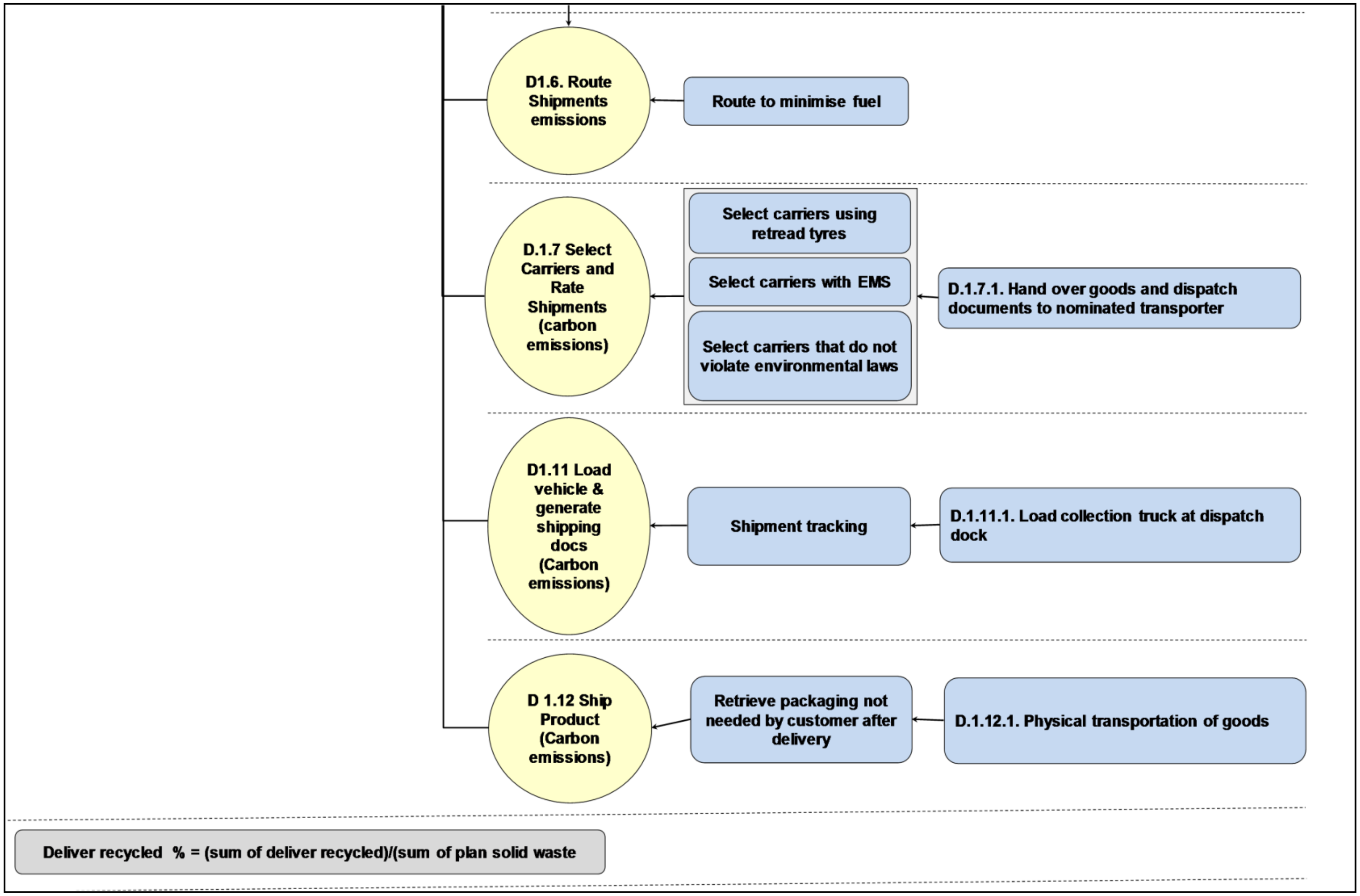


Source: (Adapted from SCC n.d. and Van Zyl 2010

8.3 Best practices related to the *deliver* process using GreenSCOR

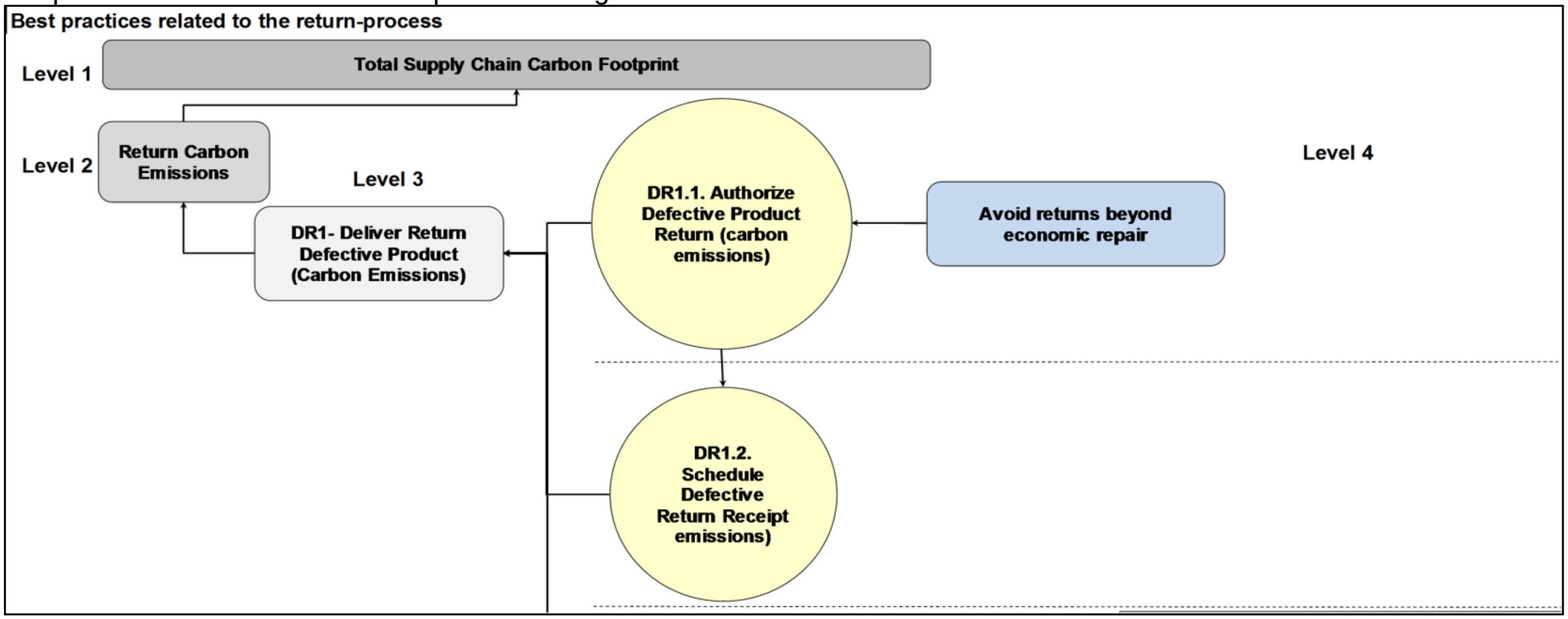


Source: (Adapted from SCC n.d. and Van Zyl 2010)

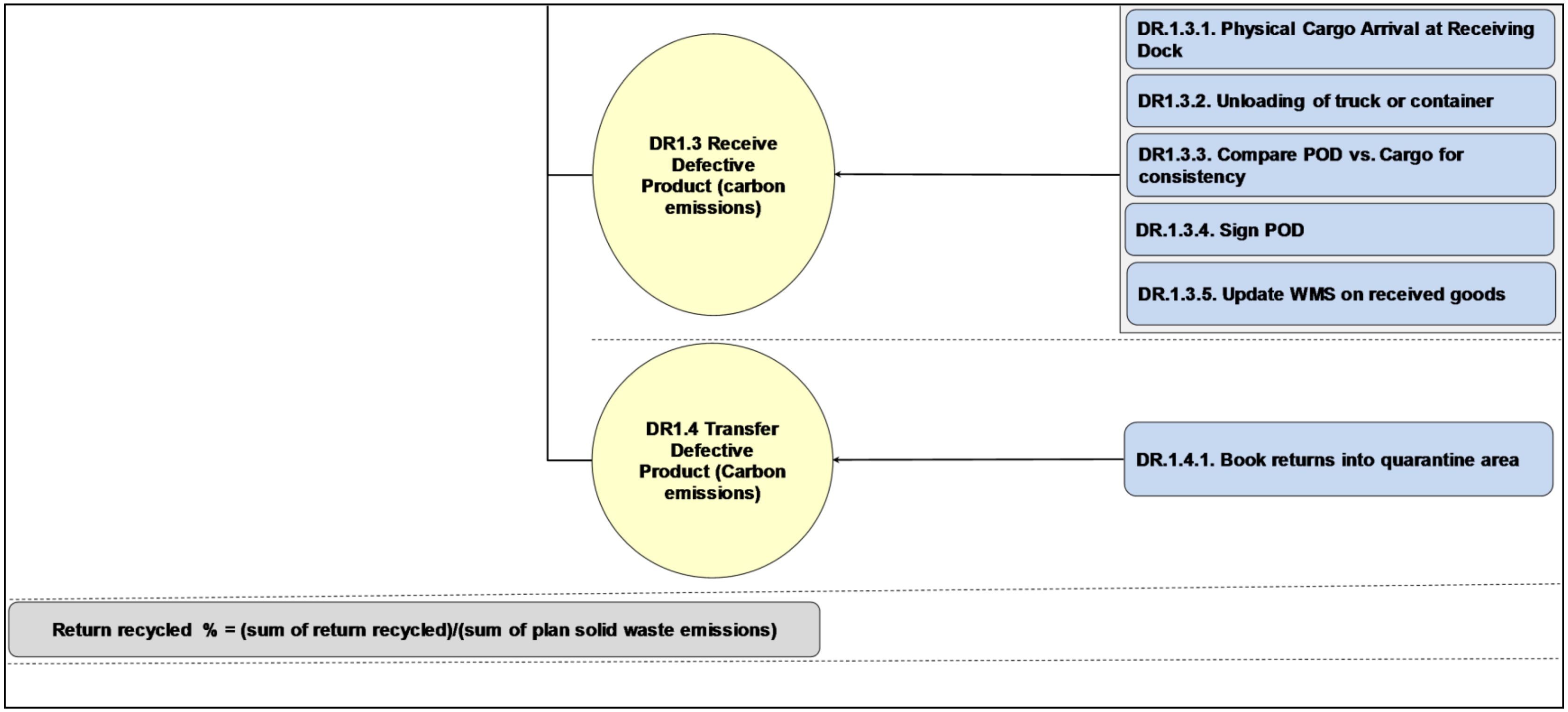


Source: (Adapted from SCC n.d. and Van Zyl 2010)

8.4 Best practices related to the *return* process using GreenSCOR



Source: (Adapted from SCC n.d. and Van Zyl 2010)



Source: (Adapted from SCC n.d. and Van Zyl 2010)

9. Appendix C

9.1 End- to-End Supply Chain Matrix – Previous Research

9.1.1 List of articles included in the Matrix

Green Supply Chain Matrix

No.	Article name	Reference	Authors	Journal	International/ South Africa
1	A decision framework for the analysis of green supply chain contracts: An evolutionary game approach	Barari,S., Agarwal,G., Zhang,W.J., Mahanty,B. & Tiwari,M.K., 2012, 'A decision framework for the analysis of green supply chain contracts: An evolutionary game approach', *Expert Systems with Applications* ,39, 2965–2976.	S. Barari, G. Agarwal, W.J. Zhang , B. Mahanty & M.K. Tiwari	Expert Systems with Applications 39 (2012) 2965–2976	International
2	Modeling carbon footprints across the supply chain	Sundarakani,B., De Souza,R., Goh,M., Wagner,S.M. & Manikandan,S., 2010,' Modelling carbon footprints across the supply chain', *International Journal of Production Economics 128, 43-50.*	B. Sundarakani, R. De Souza, M.Goh, S. M.Wagner & S.Manikandan	International Journal of Production Economics	International
3	Methodological complexities of product carbon footprinting: a sensitivity analysis of key variables in a developing country context	Plassmann,K., Norton,A., Attarzadeh,N., Jensen,M.P., Brenton,P. & Edwards-Jones,G., 2010, 'Methodological complexities of product carbon foot printing: a sensitivity analysis of key variables in a developing country context', *Environmental Science & policy* 13, 393 – 404.	K.Plassmann, A. Norton, N. Attarzadeh, M.P. Jensen, P.Brenton & G. Edwards-Jones	Environmental Science & policy 13 (2010) 3939-404 (Science direct)	International
4	Is ISO14001 a gateway to more advanced voluntry action? The case of green supply chain management	Arimura,TH., Darnall,N. & Katayama,H.,2011,'Is ISO14001 a gateway to more advanced voluntry action? The case of green supply chain management', *Journal of Environmental Economics and Management* ,61,170 – 182.	T. H. Arimura, N. Darnall & H. Katayama	Journal of Environmental Economics and Management 61(2011)170–182	International
5	Development of key performance measures for the automobile green supply chain	Olugu, E.U., Wong, K.Y., & Shaharoun, A.M., 2011, 'Development of key performance measures for the automobile green supply chain', *Resources, Conservation and Recycling* , 55, 567–579.	E.U. Olugu, K. Y. Wong & A. M. Shaharoun	Resources, Conservation and Recycling 55 (2011) 567–579	International

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No.	Article name	Reference	Authors	Journal	International/ South Africa
6	The influence of green practices on supply chain performance: A case study approach	Azevedo, S.G., Carvalho,H. & Cruz Machado,V ., 2011, 'The influence of green practices on supply chain performance: A case study approach', *Transportation Research Part E,* 47, 850–871.	S. G. Azevedo, H. Carvalho & V. Cruz Machado	Transportation Research Part E 47 (2011) 850–871	International
7	Green supply chain management implications for "closing the loop"	Zhu,Q.,Sarkis,J. & Lai,K.H., 2008, 'Green supply chain management implications for "closing the loop"', *Transportation Research* 44, 1-18.	Q. Zhu, J. Sarkis & K. Lai	Transportation Research Part E 44 (2008) 1–18	International
8	Relationships Between Environmental Impacts and Added Value Along the Supply Chain	Clift, R. & Wright, L., 2000,' Relationships between environmental impacts and added value along the supply chain', *Journal of technological forecasting and social change* 65,281-295.	R. Clift & L.Wright	Technological Forecasting and Social Change 65, 281–295 (2000)	International
9	From a literature review to a conceptual framework for sustainable supply chain management	Seuring,S. & Muller,M., 2008, 'From a literature review to a conceptual framework for sustainable supply chain management', *Journal of Cleaner Production* 16,1699–1710.	S. Seuring & M. Muller	Journal of Cleaner Production 16 (2008) 1699–1710	International
10	Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors	Walker, H., Di Sisto,L. & McBain,D., 2008, 'Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors', *Journal of Purchasing & Supply Management* 14, 69–85.	H. Walker, L. Di Sisto & D. McBain	Journal of Purchasing & Supply Management 14 (2008) 69–85	International

No.	Article name	Reference	Authors	Journal	International/ South Africa
11	Green supply chain overview and a South African case study	Schoeman,C. & Sanchez,V.R., 2009, 'Green supply chain overview and a South African case study', paper presented at the 28th Annual Southern Transport Conference, CSIR & Cardiff University Case Study, South Africa, 6-9th July.	C.Schoeman & V.R Sanchez	CSIR & Cadriff University Case Study presented at the 28th Annual Southern Transport Conference 2009 in South Africa	Local
12	Green Supply Chain Management; Critical Research and Practices	Toke,L.K., Gupta,R.C. & Dandekar,M., 2010, 'Green Supply Chain Management', Critical Research and Practices Proceedings of the 2010 International Conference on Industrial Engineering and Operations Management, Dhaka, Bangladesh, 9-10th January.	L. K. Toke, R. C. Gupta & M.Dandekar	Proceedings of the 2010 International Conference on Industrial Engineering and Operations Management, Dhaka, Bangladesh, January 9 – 10, 2010	International
13	Drivers Affecting the Green Supply Chain Management Adaptation: A Review	Jain,V.K. & Sharma,S., 2014, 'Drivers Affecting the Green Supply Chain Management Adaptation: A Review', *The IUP Journal of Operations Management,* 8(1),52-63.	V .K Jain & S. Sharma	The IUP Journal of Operations Management, Vol. XIII, No. 1, 2014	International
14	A multi-objective optimization for green supply chain network design	Wang,F., Lai,X. & Shi,N., 2011. 'A multi-objective optimization for green supply chain network design', *Decision Support Systems* , 51, 262–269.	F. Wang , X. Lai & N. Shi	Decision Support Systems 51 (2011) 262–269	International

No.	Article name	Reference	Authors	Journal	International/ South Africa
15	Do green supply chain management initiatives impact stock prices of firms?	Bose,I. & Pal,R., 2012,' Do green supply chain management initiatives impact stock prices of firms?', *Decision Support Systems* ,52,624–634.	I. Bose & R.Pal	Decision Support Systems 52 (2012) 624–634	International
16	Do green supply chains lead to competitiveness and economic performance?	Rao,P. & Holt,D., 2005, 'Do green supply chains lead to competitiveness and economic performance?', *International Journal of Operations and Production Management* , 25(9), 898-916.	P. Rao & D.Holt	International Journal of Operations and Production Management. 25:898-916.	International
17	Green as the new Lean: how to use Lean practices as a catalyst to greening your supply chain	Dües,C.M.,Tan,K.H. & Lim,M., 2013, 'Green as the new Lean: how to use Lean practices as a catalyst to greening your supply chain', *Journal of Cleaner Production* 40, 93-100.	C. M.Dües, K. H. Tan & M. Lim	Journal of Cleaner Production 40 (2013) 93e100	International
18	Integrating carbon footprint into supply chain management: the case of Hyundai Motor Company (HMC) in the automobile industry Ki-Hoon	Lee,K., 2011,'Integrating carbon footprint into supply chain management: the case of Hyundai Motor Company (HMC) in the automobile industry Ki-Hoon', *Journal of Cleaner Production* 19, 1216 – 1223.	K.Lee	Journal of Cleaner Production 19 (2011) 1216e1223	International
19	Green logistics at Eroski:A case study	Ubeda,S., Arcelus,F.J. & Faulin,J., 2011,'Green logistics at Eroski:A case study', *International Journal Production Economics* 131,44–51.	S. Ubeda, F.J.Arcelus & J.Faulin	Int. J.Production Economics 131(2011)44–51	International

No.	Article name	Reference	Authors	Journal	International/ South Africa
20	Design of sustainable supply chains under the emission trading scheme	Chaabane,A., Ramudhin,A. & Paquet.M., 2012, 'Design of sustainable supply chains under the emission trading scheme', *International Journal of Production Economics* 35, 37-49.	A. Chaabane , A.Ramudhin & M.Paquet	Int. J.Production Economics 135(2012)37–49	International
21	Measuring a carbon footprint and environmental practice: the case of Hyundai Motors Co. (HMC)	Lee,K.& Cheong,I., 2011, 'Measuring a carbon footprint and environmental practices: the case of Hyundai Motors Co. (HMC)', *Journal of Industrial and Data Systems* ,111,961-978.	K. Lee & I. Cheong	Industrial Management and Data Systems, Vol 111, No.6, pp 961 - 978 (2011)	International
22	Environmental management tools and their application - A review with references to case studies	Magerholm Fet, A., 2002, 'Environmental management tools and their application – a review with references to case studies', viewed 1 February 2015, from http://www.iot.ntnu.no/users/fet/Publi-Forfatterskap/publikasjoner/Lisboa.pdf.	A. Magerholm FET	Norwegian University of Science and Technology (NTNU), Department of Industrial Economics and Technology Management (2002)	International
23	Developing performance management systems for the green supply chain	Mutingi,M., Mapfaira,H. & Monageng,R., 2014, 'Developing performance management systems for the green supply chain', *Journal of remanufacturing* 4(6),1-20.	M. Mutingi, H. Mapfaira & R. Monageng	Journal of Remanufacturing, Vol 4, No.6, pp 1- 20 (2014)	Local
24	Performance measurement for green supply chain management	Hervani, A.A., Helms,M.M. & Sarkis,J., 2005, 'Performance measurement for green supply chain management', *Benchmarking: An International Journal* , 12(4),330-353.	A.A Hervani, M.M Helms & J. Sarkis	Benchmarking: An International Journal, vol.12, issue 4, pp 330 - 353 (2015)	International

No.	Article name	Reference	Authors	Journal	International/ South Africa
25	A strategic decision framework for green supply chain management	Sarkis,J., 2002, 'A strategic decision framework for green supply chain management', *Journal of cleaner production* 11, 397-409.	J. Sarkis	Journal of cleaner production, vol.11,pp.397-409.	International
26	Designing the green supply chain	Beamon,B.M., 1999, 'Designing the green supply chain', *Journal of logistics information management* , 12(4), 332-342.	B.M. Beamon	Journal of logistics information management, vol.12, no.4,pp332-342.	International
27	Environmental accounting: A management tool for enhancing corporate environmental and economic performance.	De Beer,P. & Friend,F., 2006, 'Environmental accounting: A management tool for enhancing corporate environmental and economic performance', Environmental Engineering Group, Department of Chemical Engineering, University of Pretoria.	P. De Beer & F. Friend		Local
28	A green supply chain is a requirement for profitability	Kumar,S., Teichman,S. & Timpernagel,T., 2011, 'A green supply chain is a requirement for profitability', *International Journal of Production Research* 50(5),1278-1296.	S. Kumar, S. Teichman & T. Timpernagel	Journal of Production Research, vol.50, no. 5,p.p 1278-1296.	International
29	Confirmation of a measurement model for green supply chain management practices implementation	Zhu,Q.,Sarkis,J. & Lai,K.H.,2008, 'Confirmation of a measurement model for green supply chain management practices implementation', *International Journal of Production Economics* 111, 261 -273.	Q. Zhu, J. Sarkis & K. Lai	International Journal of Production Economics, vol.111,pp. 261 -273.	International
30	A fuzzy goal programming approach for green supply chain optimisation under activity-based costing and performance evaluation with a value-chain structure	Tsai,W.H. & Hung,S.J., 2009, 'A fuzzy goal programming approach for green supply chain optimisation under activity-based costing and performance evaluation with a value-chain structure', *International Journal of Production Research* 47(18), 4991-5017.	W.H. Tsai & S.J.Hung	International Journal of Production Research,vol.47,no.18,pp.4991-5017.	International

No.	Article name	Reference	Authors	Journal	International/ South Africa
31	Creating a green supply chain	Khoo,H.H., Bainbridge,I., Spedding, T.A. & Taplin, D.M.R., 2001, 'Creating a green supply chain', viewed 23 November 2014, from http://airccse.org/journal/mvsc/papers/3412ijmvsc05.pdf.	H.H. Khoo, I. Bainbridge, T.A. Spedding & D.M.R. Taplin	Greenleaf Publishing	International
32	Environmental supply chain dynamics	Hall,J.,2000, 'Environmental supply chain dynamics', *Journal of Cleaner Production* 8, 455 – 471.	J.Hall	Journal of Cleaner Production	International
33	Environmental retail supply chains: when global Goliaths become environmental Davids	Kotzab,H., Munch,H.M.., Faultrier,B. & Teller,C., 2011, 'Environmental retail supply chains: when global Goliaths become environmental Davids', *International Journal of Retail and Distribution* , 39(9), 658 – 681.	H.Kotzab, H.M. Munch, B. Faultrier & C. Teller	International Journal of Retail and Distribution	International
34	Extending green practices across the supply chain - The impact of upstream and downstream integration	Vachon, S. & Klassen,R.D., 2006, 'Extending green practices across the supply chain - The impact of upstream and downstream integration', *International Journal of Operations and Production Management* , 26(7),795 – 821.	S. Vachon & R.D. Klassen	International Journal of Operations and Production Management,	International
35	Designing a mixed performance measurement system for environmental supply chain management using evolutionary game theory and balanced scorecard: A case study of an auto industry supply chain	Naini, S.G.J., Aliahmadi,A.R. & Jafari-Eskandari,M., 2011, 'Designing a mixed performance measurement system for environmental supply chain management using evolutionary game theory and balanced scorecard: A case study of an auto industry supply chain', *Journal of resources, conservation and recycling* 55, 593 – 603.	S.G.J. Naini, A.R. Aliahmadi & M. Jafari-Eskandari	Journal of resources, conservation and recycling	International

No.	Article name	Reference	Authors	Journal	International/ South Africa
36	Green supply-chain management: A state-ofthe-art literature review	Srivastava, S.K., 2007,'Green supply chain management: A state of the art literature review', *International Journal of Management Reviews* 9,53-60.	S.K. Srivastava	International Journal of Management Reviews	International
37	Using fuzzy DEMATEL to evaluate the green supply chain management practices	Lin, R., 2011, 'Using fuzzy DEMATEL to evaluate the green supply chain management practices', *Journal of cleaner production*, 1-8.	R.Lin	Journal of cleaner production,	International
38	Green supply chain management in the electronic industry	Hsu,C.W. & Hu,A.H., 2008, 'Green supply chain management in the electronic industry', *International Journal of Environmental Science and Technology* 5(2), 205-216.	C.W.Hsu & A.H. Hu	International Journal of Environmental Science and Technology	International
39	From reversed logistics to green supply chains	Van Hoek,R.I., 1999, 'From reversed logistics to green supply chains', *Journal of Supply Chain Management* 4,129-134.	R.I. Van Hoek	Journal of Supply Chain Management	International
40	Performance masurement: A conceptual framework for supply chain practices	Azfar K.R.W., Khan, N. & Gabriel,H.F., 2014, 'Performance measurement: a conceptual framework for supply chain practices', *Procedia-Social and Behavioural Sciences*,150, 803-812.	K.R.W. Azfar, Khan,N & H.F. Gabriel	Proedia - Social and Behavioral Sciences,	International

9.1.2 Research Methodology, Supply Chain Area and Industry per article

	Research methodologies applied						Core focus								Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufa ctuirng Other	Argicultural	Petroleum	Electronic	Technology	Other
1	1	1					1	1	1	1	1					1					
2				1			1	1	1	1	1					1					
3					1			1									1				
4			1				1	1				1				1					
5			1				1	1	1	1	1		1			1					

	Research methodologies applied						Core focus									Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufa ctuirng Other	Argicultural	Petroleum	Electronic	Technology	Other
6		1											1			1					
7			1										1				1	1	1	1	
8				1					1	1										1	
9	1					1								1							
10			1					1					1			1					1
11		1								1					1						
12	1					1	1	1	1	1	1										1

	Research methodologies applied						Core focus								Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufa ctuirng Other	Argicultural	Petroleum	Electronic	Technology	Other
13	1					1							1								1
14					1					1											1
15				1			1						1	1		1					
16				1				1	1	1											
17	1												1			1					
18		1						1	1	1						1					
19		1								1					1						
20				1			1	1	1	1						1					

	Research methodologies applied						Core focus								Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufacturing Other	Argicultural	Petroleum	Electronic	Technology	Other
21		1							1	1						1					
22		1							1							1					
23						1							1	1		1					
24						1							1								
25				1					1	1	1					1					

	Research methodologies applied						Core focus								Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufacutirng Other	Argicultural	Petroleum	Electronic	Technology	Other
26	1												1								
27				1									1		1						
28		1					1	1	1	1	1				1					1	
29					1		1									1					
30				1					1	1	1									1	

	Research methodologies applied						Core focus								Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufa ctuirng Other	Argicultural	Petroleum	Electronic	Technology	Other
31		1		1					1	1	1					1					
32		1						1		1	1				1						
33		1						1	1	1	1										1
34			1					1	1	1					1	1					
35				1				1	1	1	1					1					

	Research methodologies applied						Core focus								Industry						
No.	Theory	Case study	Survey / Interview	Model	Numerical Experiments	Review	Plan	Source (suppliers)	Make (manufacturing)	Deliver (Customers)	Return (Return logistics)	Enable (regulations, software)	Metrics (KPI's)	Previous research	FMCG	Manufa cturing Other	Argicultural	Petroleum	Electronic	Technology	Other
36						1								1							1
37				1			1														1
38			1	1			1	1											1		
39	1						1	1	1	1	1										1
40	1												1								
	8	11	6	12	3	6	12	17	18	21	12	1	12	4	6	18	2	1	2	4	8

10. Appendix D

10.1 DEFRA's carbon emissions detail – Fuel emissions

Activity	Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Gaseous fuels	CNG	tonnes												
		litres									0.48208	0.4805	0.00114	0.00044
		cubic metres												
		kWh	0.18639	0.18578	0.00044	0.00017	0.20711	0.20643	0.00049	0.00019				
	LNG	tonnes												
		litres									1.246481	1.2424	0.00294	0.00114
		cubic metres												
		kWh	0.18639	0.18578	0.00044	0.00017	0.20711	0.20643	0.00049	0.00019				
	LPG	tonnes												
		litres									1.52492	1.51993	0.00181	0.00318
		cubic metres												
		kWh	0.2169	0.21619	0.00026	0.00045	0.23291	0.23214	0.00028	0.00049				
	Natural gas	tonnes												
		litres												
		cubic metres									2.0548	2.0481	0.0048	0.0019
		kWh	0.18639	0.18578	0.00044	0.00017	0.20711	0.20643	0.00049	0.00019				
	Other petroleum gas	tonnes												
		litres												
		cubic metres												
		kWh	0.18825	0.18799	0.00009	0.00017	0.20461	0.20433	0.00009	0.00019				

Source: Adapted from DEFRA (n.d.)

			Energy - Gross CV				Energy - Net CV				Volume			
Activity	Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Liquid fuels	Burning oil	tonnes												
		litres									2.56088	2.54325	0.0065	0.01113
		cubic metres												
		kWh	0.24936	0.24765	0.00063	0.00108	0.26249	0.26068	0.00067	0.00114				
	Diesel (average biofuel blend)	tonnes												
		litres									2.6238	2.5863	0.0007	0.0368
		cubic metres												
		kWh	0.24813	0.24459	0.00007	0.00347	0.26396	0.2602	0.00007	0.00369				
	Fuel oil	tonnes												
		litres												
		cubic metres												
		kWh	0.27106	0.26945	0.0003	0.00131	0.28836	0.28665	0.00032	0.00139				
	Gas oil	tonnes												
		litres									3.0769	2.74725	0.00305	0.3266
		cubic metres												
		kWh	0.28667	0.25596	0.00028	0.03043	0.30496	0.27229	0.0003	0.03237				
	Lubricants	tonnes												
		litres												
		cubic metres												
		kWh	0.26753	0.26612	0.00028	0.00113	0.28461	0.28311	0.0003	0.0012				
	Petrol (average biofuel blend)	tonnes												
		litres									2.2363	2.2247	0.0036	0.008
		cubic metres												
		kWh	0.23743	0.2362	0.00038	0.00085	0.24992	0.24863	0.0004	0.00089				
	Petrol (100% mineral petrol)	tonnes												
		litres									2.34346	2.33171	0.00363	0.00812
		cubic metres												
		kWh	0.24482	0.24359	0.00038	0.00085	0.2577	0.25641	0.0004	0.00089				
	Processed fuel oils - residual oil	tonnes												
		litres												
		cubic metres												
		kWh	0.27106	0.26945	0.0003	0.00131	0.28836	0.28665	0.00032	0.00139				
	Processed fuel oils - distillate oil	tonnes												
		litres												
		cubic metres												
		kWh	0.28667	0.25596	0.00028	0.03043	0.30496	0.27229	0.0003	0.03237				
	Waste oils	tonnes												
		litres												
		cubic metres												
		kWh	0.27357	0.26612	0.00028	0.00717	0.29104	0.28311	0.0003	0.00763				

Source: Adapted from DEFRA (n.d.)

10.2 DEFRA's carbon emissions detail – Water usage

Water Usage

Activity	Type	Unit	kg CO_2e
Water supply	Water supply	cubic metres	0.344
		million litres	344.0

Source: Adapted from DEFRA (n.d.)

10.3 DEFRA's carbon emissions detail – Electricity usage

Electricity Usage

Activity	Country	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Electricity generated	Electricity: UK	kWh	2015	0.46213	0.45844	0.00035	0.00334

Source: Adapted from DEFRA (n.d.)

10.4 DEFRA's carbon emissions detail – Distribution

			Diesel				Petrol				Unknown			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Vans	Class I (up to 1.305 tonnes)	tonne.km	0.61214	0.607749	0.000215	0.004175	0.810251	0.806461	0.000831	0.002959	[redacted]			
		km	0.144477	0.143441	0.000051	0.000985	0.190714	0.189822	0.000196	0.000696				
		miles	0.232514	0.230846	0.000082	0.001586	0.306925	0.305489	0.000315	0.001121				
	Class II (1.305 to 1.74 tonnes)	tonne.km	0.633423	0.628961	0.000141	0.004321	0.806109	0.802723	0.000743	0.002643				
		km	0.228331	0.226723	0.000051	0.001558	0.2124	0.211508	0.000196	0.000696				
		miles	0.367463	0.364875	0.000082	0.002507	0.341825	0.34039	0.000315	0.001121				
	Class III (1.74 to 3.5 tonnes)	tonne.km	0.502728	0.499203	0.000095	0.00343	0.483084	0.479559	0.00041	0.003115				
		km	0.267749	0.265872	0.000051	0.001827	0.257481	0.255602	0.000218	0.00166				
		miles	0.4309	0.427879	0.000082	0.00294	0.414375	0.411352	0.000352	0.002672				
	Average (up to 3.5 tonnes)	tonne.km	0.529972	0.526249	0.000108	0.003615	0.683723	0.6804	0.000647	0.002676	0.538072	0.534333	0.000124	0.003615
		km	0.24999	0.248233	0.000051	0.001705	0.20994	0.208919	0.000199	0.000822	0.24831	0.246584	0.000057	0.001668
		miles	0.402319	0.399493	0.000082	0.002745	0.337865	0.336223	0.00032	0.001322	0.399616	0.396839	0.000092	0.002685

Source: Adapted from DEFRA (n.d.)

10.5 DEFRA's carbon emissions detail – Conversion Factors

Conversion Factors

		Symbol	Number	Standard form
Abbreviation	Kilo	k	1 000	10^{3}
	Mega	M	1 000 000	10^{6}
	Giga	G	1 000 000 000	10^{9}
	Tera	T	1 000 000 000 000	10^{12}
	Peta	P	1 000 000 000 000 000	10^{15}

		GJ	kWh	therm	toe	kcal
Energy	Gigajoule, GJ		277.78	9.47817	0.02388	238 903
	Kilowatt-hour, kWh	0.0036		0.03412	0.00009	860.05
	Therm	0.10551	29.307		0.00252	25 206
	Tonne oil equivalent, toe	41.868	11 630	396.83		10 002 389
	Kilocalorie, kcal	0.000004186	0.0011627	0.000039674	0.000000100	

		L	m^3	cu ft	Imp. gallon	US gallon	Bbl (US,P)
Volume	Litres, L		0.001	0.03531	0.21997	0.26417	0.0062898
	Cubic metres, m^3	1000		35.315	219.97	264.17	6.2898
	Cubic feet, cu ft	28.317	0.02832		6.2288	7.48052	0.17811
	Imperial gallon	4.5461	0.00455	0.16054		1.20095	0.028594
	US gallon	3.7854	0.0037854	0.13368	0.83267		0.023810
	Barrel (US, petroleum), bbl	158.99	0.15899	5.6146	34.972	42	

		kg	tonne	ton (UK)	ton (US)	lb
Weight/mass	Kilogram, kg		0.001	0.00098	0.00110	2.20462
	tonne, t (metric ton)	1000		0.98421	1.10231	2204.62368
	ton (UK, long ton)	1016.04642	1.01605		1.12000	2240
	ton (US, short ton)	907.18	0.90718	0.89286		2000
	Pound, lb	0.45359	0.00045359	0.00044643	0.00050	

		m	ft	mi	km	nmi
Length / distance	Metre, m		3.2808	0.00062137	0.001	0.00053996
	Feet, ft	0.30480		0.000	0.0003048	0.00016458
	Miles, mi	1609.34	5280		1.60934	0.86898
	Kilometres, km	1000	3280.8	0.62137		0.53996
	Nautical miles, nmi or NM	1852	6076.1	1.15078	1.852	

		m	ft	in	cm	yd
Length / distance	Metre, m		3.28084	39.37008	100	1.09361
	Feet, ft	0.30480		12	30.48000	0.33333
	Inch, in	0.02540	0.08333		2.54000	0.02778
	Centimetres, cm	0.01	0.03281	0.39370		0.01094
	Yard, yd	0.91440	3	36	91.44000	

Source: Adapted from DEFRA (n.d.)

11. Appendix E

11.1 Costing Models – Baseline Result Sheet Extract from Green Business Profitability Framework

ID'S		Levels										Sales Data		
Unique Identifier	Scenario	Export	Business Type	Region	Category	Group	DC	Brand	Route	Cust. ID	Customer Name	Sum of Sum o	Sum of Sum	Sum of Sun
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 111CUSTOMER 1	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	1	1	CUSTOMER 1	3 990 160	62 311	29 357
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 122CUSTOMER 2	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	2	2	CUSTOMER 2	1 793 214	28 227	12 764
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 133CUSTOMER 3	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	3	3	CUSTOMER 3	126 351	2 591	1 263
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 144CUSTOMER 4	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	4	4	CUSTOMER 4	289 561	6 402	3 244
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 155CUSTOMER 5	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	5	5	CUSTOMER 5	3 904 776	96 802	51 223
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 166CUSTOMER 6	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	6	6	CUSTOMER 6	2 307 566	50 417	25 564
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 177CUSTOMER 7	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	7	7	CUSTOMER 7	1 846 932	39 895	21 016
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 188CUSTOMER 8	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	8	8	CUSTOMER 8	259 784	5 447	2 876
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 199CUSTOMER 9	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	9	9	CUSTOMER 9	1 485 121	35 541	18 701
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11010CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	10	10	CUSTOMER 10	807 599	18 760	9 269
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11111CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	11	11	CUSTOMER 11	16 687 777	481 692	251 413
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11212CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	12	12	CUSTOMER 12	14 117 177	363 781	159 695
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11313CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	13	13	CUSTOMER 13	264 431	4 665	2 144
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11414CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	14	14	CUSTOMER 14	398 448	7 018	2 838
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11515CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	15	15	CUSTOMER 15	340 669	5 912	3 120
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11616CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	16	16	CUSTOMER 16	82 475	1 540	714
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11717CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	17	17	CUSTOMER 17	437 765	7 485	3 543
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11818CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	18	18	CUSTOMER 18	19 063	325	156
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11919CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	19	19	CUSTOMER 19	796	11	4
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12020CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	20	20	CUSTOMER 20	92 167	1 336	642
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12121CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	21	21	CUSTOMER 21	112 364	1 574	737
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12222CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	22	22	CUSTOMER 22	460 447	9 876	4 781
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12323CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	23	23	CUSTOMER 23	761 192	16 355	7 725
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12424CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	24	24	CUSTOMER 24	101 166	1 677	934
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12525CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	25	25	CUSTOMER 25	43 797	1 225	540
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12626CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	26	26	CUSTOMER 26	143 517	2 659	1 331
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12727CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 1	27	27	CUSTOMER 27	6 107	116	47
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 32828CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 3	28	28	CUSTOMER 28	1 368	20	6
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 22929CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	29	29	CUSTOMER 29	20 900 690	348 531	166 839
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23030CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	30	30	CUSTOMER 30	11 582 576	194 653	92 396
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23131CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	31	31	CUSTOMER 31	670 895	19 535	9 207
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23232CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	32	32	CUSTOMER 32	7 410 108	176 550	87 733
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23333CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	33	33	CUSTOMER 33	2 763 874	63 955	32 309
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23434CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	34	34	CUSTOMER 34	922 440	21 327	10 507
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23535CUSTOMER	Basecase	Export	Core	Exports	Exports	Exports	Exports	PRODUCT 2	35	35	CUSTOMER 35	6 895 238	212 408	90 392

ID'S	Sales Data			Production Data							
Unique Identifier	Sum of Sum o	Sum of Sum (	Sum of Sun	Directs	Coman Direct	Manfacturing Overheads Expens	Manfacturing Overhead	MOH Fixed	MOH Variable	MOH Total	Total Productio
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 111CUSTOMER 1	3 990 160	62 311	29 357	1 375 401	-	10 457	-	236 166	127 789	363 956	1 749 813
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 122CUSTOMER 2	1 793 214	28 227	12 764	623 070	-	4 737	-	106 986	57 890	164 875	792 682
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 133CUSTOMER 3	126 351	2 591	1 263	57 182	-	435	-	9 819	5 313	15 131	72 748
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 144CUSTOMER 4	289 561	6 402	3 244	141 312	-	1 074	-	24 264	13 129	37 394	179 780
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 155CUSTOMER 5	3 904 776	96 802	51 223	2 136 748	-	16 245	-	366 895	198 526	565 422	2 718 414
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 166CUSTOMER 6	2 307 566	50 417	25 564	1 112 860	-	8 461	-	191 086	103 396	294 483	1 415 804
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 177CUSTOMER 7	1 846 932	39 895	21 016	880 621	-	6 695	-	151 209	81 819	233 028	1 120 344
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 188CUSTOMER 8	259 784	5 447	2 876	120 243	-	914	-	20 647	11 172	31 818	152 976
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 199CUSTOMER 9	1 485 121	35 541	18 701	784 497	-	5 964	-	134 704	72 888	207 592	998 053
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11010CUSTOMER	807 599	18 760	9 269	414 099	-	3 148	-	71 104	38 474	109 578	526 825
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11111CUSTOMER	16 687 777	481 692	251 413	10 632 526	-	80 835	-	1 825 683	987 874	2 813 557	13 526 918
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11212CUSTOMER	14 117 177	363 781	159 695	8 029 849	-	61 048	-	1 378 784	746 058	2 124 842	10 215 739
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11313CUSTOMER	264 431	4 665	2 144	102 981	-	783	-	17 683	9 568	27 251	131 015
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11414CUSTOMER	398 448	7 018	2 838	154 918	-	1 178	-	26 601	14 394	40 994	197 090
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11515CUSTOMER	340 669	5 912	3 120	130 497	-	992	-	22 407	12 125	34 532	166 021
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11616CUSTOMER	82 475	1 540	714	33 982	-	258	-	5 835	3 157	8 992	43 232
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11717CUSTOMER	437 765	7 485	3 543	165 219	-	1 256	-	28 369	15 351	43 720	210 196
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11818CUSTOMER	19 063	325	156	7 177	-	55	-	1 232	667	1 899	9 131
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 11919CUSTOMER	796	11	4	232	-	2	-	40	22	61	295
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12020CUSTOMER	92 167	1 336	642	29 498	-	224	-	5 065	2 741	7 806	37 527
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12121CUSTOMER	112 364	1 574	737	34 749	-	264	-	5 967	3 229	9 195	44 209
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12222CUSTOMER	460 447	9 876	4 781	217 994	-	1 657	-	37 431	20 254	57 685	277 337
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12323CUSTOMER	761 192	16 355	7 725	361 007	-	2 745	-	61 988	33 541	95 529	459 281
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12424CUSTOMER	101 166	1 677	934	37 011	-	281	-	6 355	3 439	9 794	47 086
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12525CUSTOMER	43 797	1 225	540	27 038	-	206	-	4 643	2 512	7 155	34 399
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12626CUSTOMER	143 517	2 659	1 331	58 687	-	446	-	10 077	5 453	15 530	74 662
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 12727CUSTOMER	6 107	116	47	2 552	-	19	-	438	237	675	3 247
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 32828CUSTOMER	1 368	20	6	445	-	3	-	76	41	118	566
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 22929CUSTOMER	20 900 690	348 531	166 839	7 693 227	-	58 489	-	1 320 984	714 782	2 035 766	9 787 482
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23030CUSTOMER	11 582 576	194 653	92 396	4 296 622	-	32 666	-	737 762	399 202	1 136 963	5 466 251
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23131CUSTOMER	670 895	19 535	9 207	431 199	-	3 278	-	74 040	40 063	114 103	548 581
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23232CUSTOMER	7 410 108	176 550	87 733	3 897 048	-	29 628	-	669 152	362 077	1 031 229	4 957 905
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23333CUSTOMER	2 763 874	63 955	32 309	1 411 697	-	10 733	-	242 399	131 162	373 560	1 795 990
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23434CUSTOMER	922 440	21 327	10 507	470 749	-	3 579	-	80 831	43 738	124 569	598 897
BasecaseExportCoreExportsExportsExportsExportsPRODUCT 23535CUSTOMER	6 895 238	212 408	90 392	4 688 538	-	35 645	-	805 056	435 615	1 240 671	5 964 854

11.2 Green Business Profitability Framework - Per level detail

11.2.1.Sub-Business Level View – L2

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
Sub Business Level 1	1 684 437 908	327 905 433	1 356 532 475	832 527 828	524 004 647	39%	53 553 727	470 450 920	35%	92 120 610	378 330 310	28%
Sub Business Level 2	970 537 076	161 948 568	808 588 507	480 412 978	328 175 529	41%	39 507 818	288 667 711	36%	62 247 133	226 420 578	28%
Sub Business Level 3	2 106 502	238 749	1 867 753	660 878	1 206 875	65%	-	1 206 875	65%	-	1 206 875	65%
Sub Business Level 4	11 038	9 243	1 795	-	1 795	100%	-	1 795	100%	-	1 795	100%
Sub Business Level 5	305 910 386	38 713 587	267 196 799	225 300 969	41 895 830	16%	12 786 057	29 109 774	11%	24 799 125	4 310 649	2%
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**38%**	105 847 602	789 437 075	34%	179 166 868	610 270 207	27%

Profitability Per Business Level

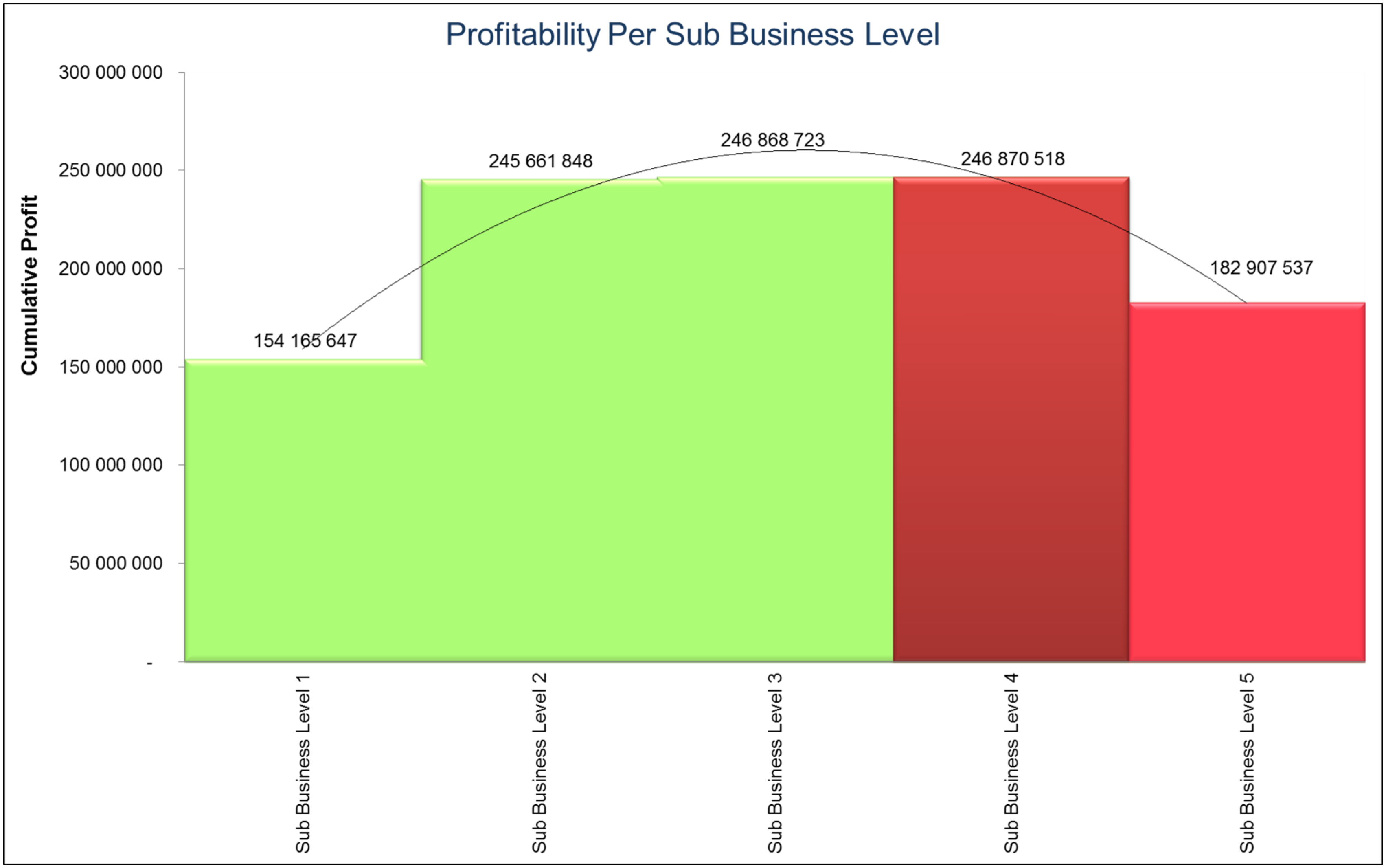
Business Level	Gross Revenue	Discount & Allowances (D&A)	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
Sub Business Level 1	1 684 437 908	327 905 433	104 319 330	274 010 980	20%	66 041 154	207 969 826	15%	53 804 179	154 165 647	11%	25 351 213
Sub Business Level 2	970 537 076	161 948 568	81 576 408	144 844 170	18%	50 124 386	94 719 784	12%	3 223 583	91 496 201	11%	19 241 245
Sub Business Level 3	2 106 502	238 749	-	1 206 875	65%	-	1 206 875	65%	-	1 206 875	65%	23 534
Sub Business Level 4	11 038	9 243	-	1 795	100%	-	1 795	100%	-	1 795	100%	22
Sub Business Level 5	305 910 386	38 713 587	36 475 784	(32 165 135)	-12%	29 314 152	(61 479 287)	-23%	2 483 695	(63 962 982)	-24%	11 252 821
Total	**2 963 002 909**	**528 815 580**	222 371 522	387 898 685	18%	145 479 691	242 418 994	12%	59 511 457	182 907 537	9%	55 868 835

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
Sub Business Level 1	66.44	12.93	53.51	32.84	20.67	2.11	18.56	3.63	14.92	4.11	10.81	2.61	8.20	2.12	6.08
Sub Business Level 2	50.44	8.42	42.02	24.97	17.06	2.05	15.00	3.24	11.77	4.24	7.53	2.61	4.92	0.17	4.76
Sub Business Level 3	89.51	10.14	79.36	28.08	51.28	-	51.28	-	51.28	-	51.28	-	51.28	-	51.28
Sub Business Level 4	511.02	427.90	83.12	-	83.12	-	83.12	-	83.12	-	83.12	-	83.12	-	83.12
Sub Business Level 5	27.19	3.44	23.74	20.02	3.72	1.14	2.59	2.20	0.38	3.24	-2.86	2.61	-5.46	0.22	-5.68

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
Sub Business Level 1	49%	31%	3%	28%	5%	22%	6%	16%	4%	12.3%	3%	9.2%
Sub Business Level 2	**49%**	**34%**	**4%**	**30%**	**6%**	**23%**	**8%**	**15%**	**5%**	**9.8%**	**0%**	**9.4%**
Sub Business Level 3	31%	57%	0%	57%	0%	57%	0%	57%	0%	57.3%	0%	57.3%
Sub Business Level 4	**0%**	**16%**	**0%**	**16%**	**0%**	**16%**	**0%**	**16%**	**0%**	**16.3%**	**0%**	**16.3%**
Sub Business Level 5	74%	14%	4%	10%	8%	1%	12%	-11%	10%	-20.1%	1%	-20.9%



Profitability Per Sub Business Level
Cumulative Profit
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
154 165 647
245 661 848
246 868 723
246 870 518
182 907 537
Sub Business Level 1
Sub Business Level 2
Sub Business Level 3
Sub Business Level 4
Sub Business Level 5

11.2.2. Sales Region Business Level View – L3

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
Sales Region 1	840 166 935	130 167 264	709 999 671	371 918 791	338 080 880	48%	22 419 862	315 661 018	44%	48 858 779	266 802 239	38%
Sales Region 2	324 431 799	51 738 407	272 693 391	149 159 108	123 534 284	45%	12 154 812	111 379 472	41%	22 378 208	89 001 263	33%
Sales Region 3	232 681 704	31 934 442	200 747 263	105 488 859	95 258 404	47%	10 286 153	84 972 251	42%	15 378 692	69 593 560	35%
Sales Region 4	63 565 669	10 987 537	52 578 132	30 194 478	22 383 654	43%	1 325 302	21 058 352	40%	1 997 655	19 060 697	36%
Sales Region 5	228 825 296	81 605 377	147 219 918	93 133 627	54 086 291	37%	2 900 481	51 185 810	35%	21 237 073	29 948 737	20%
Sales Region 6	53 574 478	5 377 984	48 196 494	35 323 259	12 873 235	27%	666 026	12 207 208	25%	2 188 972	10 018 237	21%
Sales Region 7	454 226 947	79 121 754	375 105 193	267 540 460	107 564 732	29%	24 266 160	83 298 573	22%	26 780 824	56 517 749	15%
Sales Region 8	613 799 520	102 855 328	510 944 192	382 076 190	128 868 002	25%	22 967 120	105 900 882	21%	32 039 110	73 861 772	14%
Sales Region 9	151 730 561	35 027 485	116 703 076	104 067 881	12 635 195	11%	8 861 686	3 773 508	3%	8 307 554	(4 534 046)	-4%
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25%**

Profitability Per Business Level

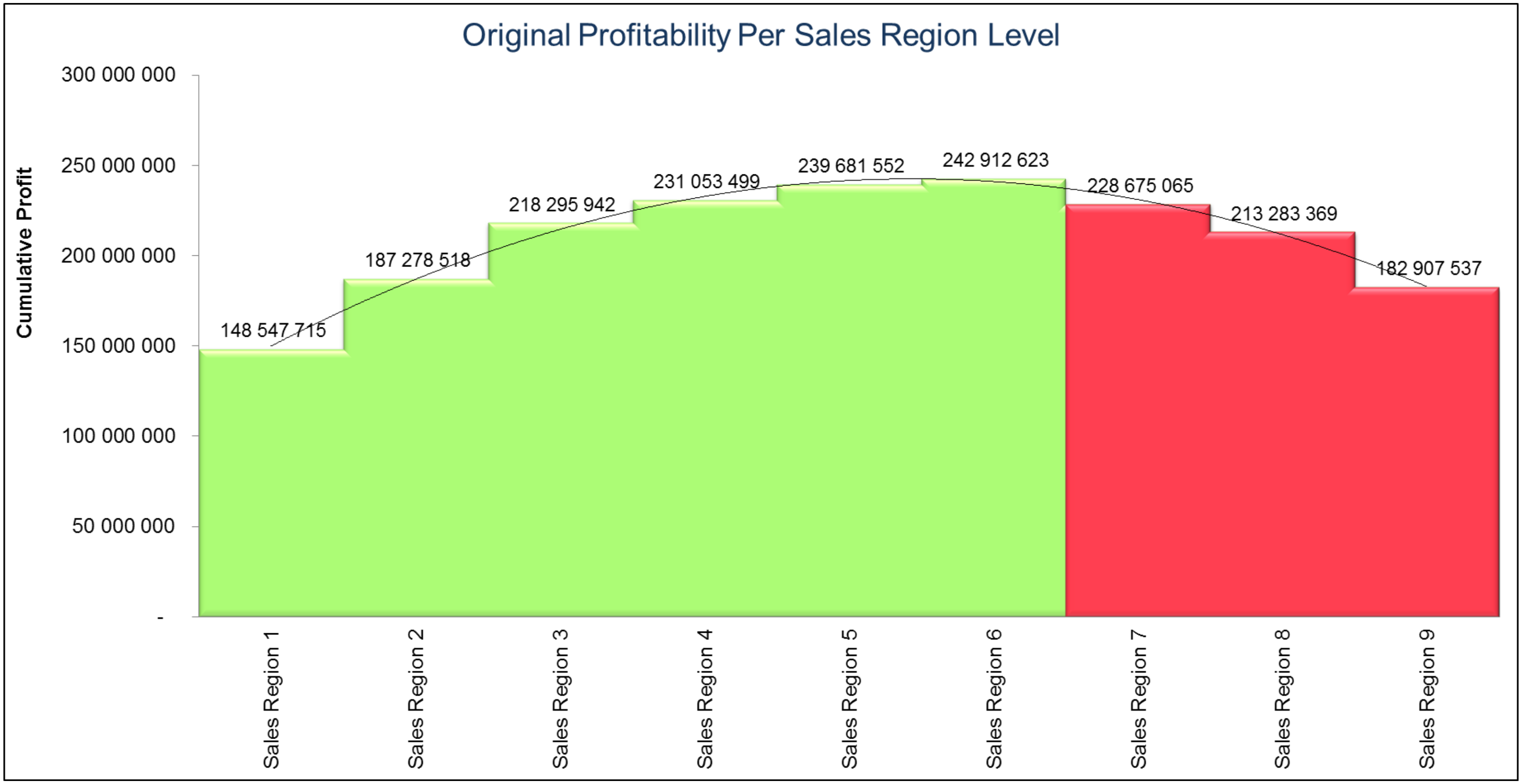
Business Level	Gross Revenue	Discount & Allowances (D&A)	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
Sales Region 1	840 166 935	130 167 264	63 908 720	202 893 519	29%	38 133 870	164 759 649	23%	16 211 934	148 547 715	21%	14 661 980
Sales Region 2	324 431 799	51 738 407	28 252 238	60 749 026	22%	15 849 323	44 899 702	16%	6 168 899	38 730 803	14%	6 084 079
Sales Region 3	232 681 704	31 934 442	23 406 191	46 187 369	23%	10 767 433	35 419 936	18%	4 402 513	31 017 423	15%	4 133 298
Sales Region 4	63 565 669	10 987 537	2 468 586	16 592 111	32%	2 652 604	13 939 507	27%	1 181 950	12 757 558	24%	1 018 255
Sales Region 5	228 825 296	81 605 377	5 315 693	24 633 043	17%	9 219 942	15 413 102	10%	6 785 049	8 628 053	6%	3 539 258
Sales Region 6	53 574 478	5 377 984	1 108 394	8 909 842	18%	5 086 489	3 823 354	8%	592 283	3 231 070	7%	1 952 550
Sales Region 7	454 226 947	79 121 754	39 944 890	16 572 858	4%	23 416 490	(6 843 632)	-2%	7 393 926	(14 237 558)	-4%	8 988 904
Sales Region 8	613 799 520	102 855 328	44 749 488	29 112 284	6%	31 278 131	(2 165 847)	0%	13 225 849	(15 391 696)	-3%	12 006 734
Sales Region 9	151 730 561	35 027 485	13 217 322	(17 751 367)	-15%	9 075 410	(26 826 778)	-23%	3 549 054	(30 375 832)	-26%	3 483 777
Total	**2 963 002 909**	**528 815 580**	**222 371 522**	**387 898 685**	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
Sales Region 1	57.30	8.88	48.42	25.37	23.06	1.53	21.53	3.33	18.20	4.36	13.84	2.60	11.24	1.11	10.13
Sales Region 2	**53.32**	**8.50**	**44.82**	**24.52**	**20.30**	**2.00**	**18.31**	**3.68**	**14.63**	**4.64**	**9.98**	**2.61**	**7.38**	**1.01**	**6.37**
Sales Region 3	56.29	7.73	48.57	25.52	23.05	2.49	20.56	3.72	16.84	5.66	11.17	2.61	8.57	1.07	7.50
Sales Region 4	**62.43**	**10.79**	**51.64**	**29.65**	**21.98**	**1.30**	**20.68**	**1.96**	**18.72**	**2.42**	**16.29**	**2.61**	**13.69**	**1.16**	**12.53**
Sales Region 5	64.65	23.06	41.60	26.31	15.28	0.82	14.46	6.00	8.46	1.50	6.96	2.61	4.35	1.92	2.44
Sales Region 6	**27.44**	**2.75**	**24.68**	**18.09**	**6.59**	**0.34**	**6.25**	**1.12**	**5.13**	**0.57**	**4.56**	**2.61**	**1.96**	**0.30**	**1.65**
Sales Region 7	50.53	8.80	41.73	29.76	11.97	2.70	9.27	2.98	6.29	4.44	1.84	2.61	-0.76	0.82	-1.58
Sales Region 8	**51.12**	**8.57**	**42.55**	**31.82**	**10.73**	**1.91**	**8.82**	**2.67**	**6.15**	**3.73**	**2.42**	**2.61**	**-0.18**	**1.10**	**-1.28**
Sales Region 9	43.55	10.05	33.50	29.87	3.63	2.54	1.08	2.38	-1.30	3.79	-5.10	2.61	-7.70	1.02	-8.72

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
Sales Region 1	44%	40%	3%	38%	6%	32%	8%	24%	5%	19.6%	2%	17.7%
Sales Region 2	46%	38%	4%	34%	7%	27%	9%	19%	5%	13.8%	2%	11.9%
Sales Region 3	45%	41%	4%	37%	7%	30%	10%	20%	5%	15.2%	2%	13.3%
Sales Region 4	48%	35%	2%	33%	3%	30%	4%	26%	4%	21.9%	2%	20.1%
Sales Region 5	41%	24%	1%	22%	9%	13%	2%	11%	4%	6.7%	3%	3.8%
Sales Region 6	66%	24%	1%	23%	4%	19%	2%	17%	9%	7.1%	1%	6.0%
Sales Region 7	59%	24%	5%	18%	6%	12%	9%	4%	5%	-1.5%	2%	-3.1%
Sales Region 8	62%	21%	4%	17%	5%	12%	7%	5%	5%	-0.4%	2%	-2.5%
Sales Region 9	69%	8%	6%	2%	5%	-3%	9%	-12%	6%	-17.7%	2%	-20.0%


Original Profitability Per Sales Region Level
Cumulative Profit
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
148 547 715
187 278 518
218 295 942
231 053 499
239 681 552
242 912 623
228 675 065
213 283 369
182 907 537
Sales Region 1
Sales Region 2
Sales Region 3
Sales Region 4
Sales Region 5
Sales Region 6
Sales Region 7
Sales Region 8
Sales Region 9

11.2.3. DTS Category Level View – L4

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
DTS Category 1	449 056 888	25 792 339	423 264 549	239 420 964	183 843 585	43%	19 104 688	164 738 898	39%	33 138 468	131 600 429	31%
DTS Category 2	1 226 897 321	290 348 811	936 548 509	606 071 058	330 477 451	35%	44 523 878	285 953 573	31%	62 381 164	223 572 409	24%
DTS Category 3	183 104 331	15 269 868	167 834 462	85 575 242	82 259 221	49%	7 783 873	74 475 348	44%	10 457 646	64 017 702	38%
DTS Category 4	749 686 656	91 520 760	658 165 895	444 774 774	213 391 121	32%	28 119 686	185 271 435	28%	42 071 268	143 200 167	22%
DTS Category 5	19 459 833	2 680	19 457 152	7 844 586	11 612 566	60%	926 957	10 685 609	55%	1 230 239	9 455 370	49%
DTS Category 6	332 493 197	105 641 541	226 851 656	154 467 647	72 384 009	32%	5 381 172	67 002 836	30%	29 872 708	37 130 129	16%
DTS Category 7	2 106 502	238 749	1 867 753	660 878	1 206 875	65%	-	1 206 875	65%	-	1 206 875	65%
DTS Category 8	198 182	830	197 352	87 503	109 849	56%	7 348	102 501	52%	15 376	87 126	44%
DTS Category 9	-	-	-	-	-	0%	-	-	0%	-	-	0%
Total	2 963 002 909	528 815 580	2 434 187 330	1 538 902 653	895 284 677	37%	105 847 602	789 437 075	32%	179 166 868	610 270 207	25%

Profitability Per Business Level

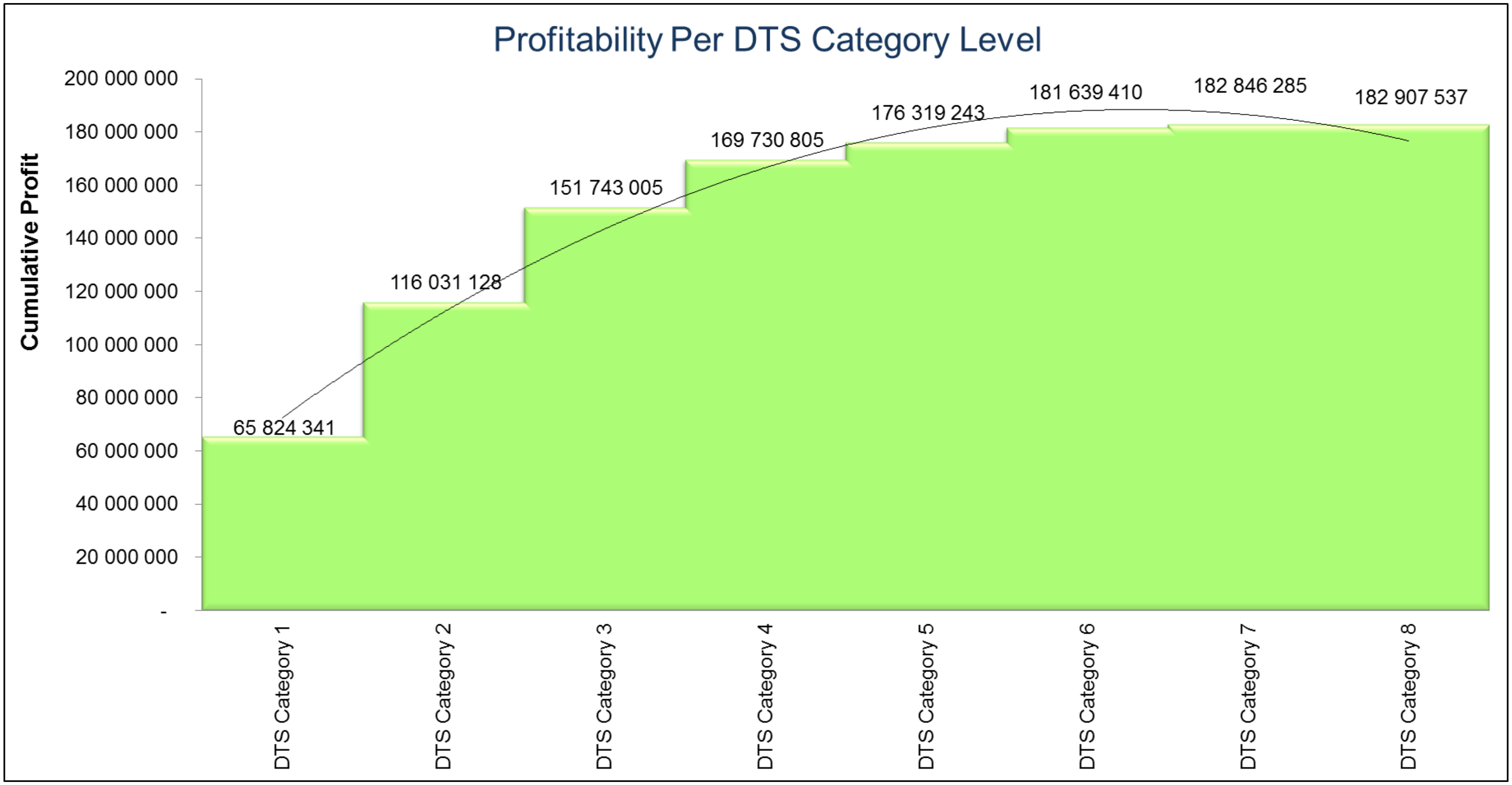
Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5 %	Advertising & Marketing (A&M)	GP6	GP6 %	Invoice Sales Volume (kg)
DTS Category 1	449 056 888	25 792 339	423 264 549	239 420 964	34 378 000	97 222 429	23%	22 193 494	75 028 935	18%	9 204 594	65 824 341	16%	8 519 432
DTS Category 2	**1 226 897 321**	**290 348 811**	**936 548 509**	**606 071 058**	**95 100 134**	**128 472 275**	**14%**	**53 405 754**	**75 066 521**	**8%**	**24 859 733**	**50 206 788**	**5%**	**20 500 863**
DTS Category 3	183 104 331	15 269 868	167 834 462	85 575 242	17 344 677	46 673 025	28%	7 560 256	39 112 768	23%	3 400 892	35 711 876	21%	2 902 160
DTS Category 4	**749 686 656**	**91 520 760**	**658 165 895**	**444 774 774**	**67 007 987**	**76 192 180**	**12%**	**46 149 375**	**30 042 805**	**5%**	**12 055 005**	**17 987 800**	**3%**	**17 715 357**
DTS Category 5	19 459 833	2 680	19 457 152	7 844 586	888 882	8 566 489	44%	1 639 151	6 927 338	36%	338 900	6 588 438	34%	629 221
DTS Category 6	**332 493 197**	**105 641 541**	**226 851 656**	**154 467 647**	**7 638 259**	**29 491 870**	**13%**	**14 523 419**	**14 968 451**	**7%**	**9 648 284**	**5 320 167**	**2%**	**5 575 104**
DTS Category 7	2 106 502	238 749	1 867 753	660 878	-	1 206 875	65%	-	1 206 875	65%	-	1 206 875	65%	23 534
DTS Category 8	**198 182**	**830**	**197 352**	**87 503**	**13 583**	**73 543**	**37%**	**8 243**	**65 300**	**33%**	**4 049**	**61 252**	**31%**	**3 164**
DTS Category 9	-	-	-	-	-	-	0%	-	-	0%	-	-	0%	-
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**222 371 522**	**387 898 685**	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
DTS Category 1	52.71	3.03	49.68	28.10	21.58	2.24	19.34	3.89	15.45	4.04	11.41	2.61	8.81	1.08	7.73
DTS Category 2	**59.85**	**14.16**	**45.68**	**29.56**	**16.12**	**2.17**	**13.95**	**3.04**	**10.91**	**4.64**	**6.27**	**2.61**	**3.66**	**1.21**	**2.45**
DTS Category 3	63.09	5.26	57.83	29.49	28.34	2.68	25.66	3.60	22.06	5.98	16.08	2.61	13.48	1.17	12.31
DTS Category 4	**42.32**	**5.17**	**37.15**	**25.11**	**12.05**	**1.59**	**10.46**	**2.37**	**8.08**	**3.78**	**4.30**	**2.61**	**1.70**	**0.68**	**1.02**
DTS Category 5	30.93	0.00	30.92	12.47	18.46	1.47	16.98	1.96	15.03	1.41	13.61	2.61	11.01	0.54	10.47
DTS Category 6	**59.64**	**18.95**	**40.69**	**27.71**	**12.98**	**0.97**	**12.02**	**5.36**	**6.66**	**1.37**	**5.29**	**2.61**	**2.68**	**1.73**	**0.95**
DTS Category 7	89.51	10.14	79.36	28.08	51.28	-	51.28	-	51.28	-	51.28	-	51.28	-	51.28
DTS Category 8	**62.63**	**0.26**	**62.37**	**27.65**	**34.72**	**2.32**	**32.39**	**4.86**	**27.54**	**4.29**	**23.24**	**2.61**	**20.64**	**1.28**	**19.36**
DTS Category 9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
DTS Category 1	53%	41%	4%	37%	7%	29%	8%	22%	5%	16.7%	2%	14.7%
DTS Category 2	49%	27%	4%	23%	5%	18%	8%	10%	4%	6.1%	2%	4.1%
DTS Category 3	47%	45%	4%	41%	6%	35%	9%	25%	4%	21.4%	2%	19.5%
DTS Category 4	59%	28%	4%	25%	6%	19%	9%	10%	6%	4.0%	2%	2.4%
DTS Category 5	40%	60%	5%	55%	6%	49%	5%	44%	8%	35.6%	2%	33.9%
DTS Category 6	46%	22%	2%	20%	9%	11%	2%	9%	4%	4.5%	3%	1.6%
DTS Category 7	31%	57%	0%	57%	0%	57%	0%	57%	0%	57.3%	0%	57.3%
DTS Category 8	44%	55%	4%	52%	8%	44%	7%	37%	4%	32.9%	2%	30.9%
DTS Category 9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0%	0.0%


Profitability Per DTS Category Level
Cumulative Profit
200 000 000
180 000 000
160 000 000
140 000 000
120 000 000
100 000 000
80 000 000
60 000 000
40 000 000
20 000 000
-
65 824 341
116 031 128
151 743 005
169 730 805
176 319 243
181 639 410
182 846 285
182 907 537
DTS Category 1
DTS Category 2
DTS Category 3
DTS Category 4
DTS Category 5
DTS Category 6
DTS Category 7
DTS Category 8

11.2.4. Major Group Level View – L5

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
Major Group 1	285 216 858	2 006 711	283 210 147	134 002 454	149 207 693	53%	12 436 668	136 771 025	48%	21 929 245	114 841 780	41%
Major Group 2	**379 618 716**	**45 885 101**	**333 733 615**	**186 830 647**	**146 902 968**	**44%**	**12 602 544**	**134 300 423**	**40%**	**19 523 611**	**114 776 812**	**34%**
Major Group 3	413 116 341	47 081 307	366 035 033	245 391 939	120 643 095	33%	14 802 400	105 840 694	29%	22 264 995	83 575 699	23%
Major Group 4	**42 365 792**	**3 532 625**	**38 833 167**	**18 630 333**	**20 202 834**	**52%**	**1 360 766**	**18 842 067**	**49%**	**2 300 269**	**16 541 799**	**43%**
Major Group 5	55 654 835	5 384 010	50 270 825	25 575 624	24 695 201	49%	2 374 405	22 320 795	44%	3 155 271	19 165 524	38%
Major Group 6	**28 819 102**	**1 780 900**	**27 038 202**	**12 815 857**	**14 222 345**	**53%**	**888 785**	**13 333 560**	**49%**	**1 586 037**	**11 747 523**	**43%**
Major Group 7	33 867 037	7 061 606	26 805 432	13 656 748	13 148 684	49%	481 305	12 667 378	47%	1 326 779	11 340 600	42%
Major Group 8	**452 969 192**	**119 686 170**	**333 283 022**	**223 159 442**	**110 123 580**	**33%**	**15 766 861**	**94 356 719**	**28%**	**23 597 332**	**70 759 387**	**21%**
Major Group 9	28 752 812	1 279 871	27 472 941	13 301 100	14 171 841	52%	1 255 582	12 916 258	47%	1 671 573	11 244 686	41%
Major Group 10	**19 459 833**	**2 680**	**19 457 152**	**7 844 586**	**11 612 566**	**60%**	**926 957**	**10 685 609**	**55%**	**1 230 239**	**9 455 370**	**49%**
Major Group 11	32 362 922	2 587 203	29 775 719	15 364 904	14 410 815	48%	1 366 375	13 044 441	44%	1 862 627	11 181 814	38%
Major Group 12	**332 493 197**	**105 641 541**	**226 851 656**	**154 467 647**	**72 384 009**	**32%**	**5 381 172**	**67 002 836**	**30%**	**29 872 708**	**37 130 129**	**16%**
Major Group 13	24 094 669	2 074 310	22 020 359	10 760 081	11 260 278	51%	1 018 659	10 241 619	47%	1 418 711	8 822 908	40%
Major Group 14	**336 570 020**	**44 439 453**	**292 130 567**	**199 382 725**	**92 747 842**	**32%**	**13 317 273**	**79 430 569**	**27%**	**19 806 255**	**59 624 313**	**20%**
Major Group 15	25 897 697	2 867 256	23 030 441	12 715 163	10 315 278	45%	1 065 805	9 249 473	40%	1 428 242	7 821 231	34%
Major Group 16	**14 984 949**	**139 153**	**14 845 796**	**7 265 047**	**7 580 749**	**51%**	**638 427**	**6 942 322**	**47%**	**1 259 218**	**5 683 105**	**38%**
Major Group 17	16 319 349	1 076 857	15 242 492	7 848 842	7 393 650	49%	702 356	6 691 294	44%	919 425	5 771 869	38%
Major Group 18	**6 945 690**	**18 601**	**6 927 089**	**3 056 712**	**3 870 377**	**56%**	**246 781**	**3 623 596**	**52%**	**234 244**	**3 389 352**	**49%**
Major Group 19	2 106 502	238 749	1 867 753	660 878	1 206 875	65%	-	1 206 875	65%	-	1 206 875	65%
Major Group 20	**198 182**	**830**	**197 352**	**87 503**	**109 849**	**56%**	**7 348**	**102 501**	**52%**	**15 376**	**87 126**	**44%**
Major Group 21	22 046	361	21 685	9 527	12 158	56%	691	11 467	53%	1 797	9 671	45%
Major Group 22	**295**	**-**	**295**	**110**	**185**	**63%**	**13**	**172**	**58%**	**17**	**154**	**52%**
Major Group 23	-	-	-	-	-	0%	-	-	0%	-	-	0%
Major Group 24	**5 341 033**	**4 012 955**	**1 328 077**	**2 764 552**	**(1 436 475)**	**-108%**	**177 800**	**(1 614 274)**	**-122%**	**773 679**	**(2 387 953)**	**-180%**
Major Group 25	72 329 155	14 319 994	58 009 161	63 942 722	(5 933 561)	-10%	3 602 242	(9 535 803)	-16%	5 290 022	(14 825 825)	-26%
Major Group 26	**353 496 685**	**117 697 334**	**235 799 352**	**179 367 509**	**56 431 843**	**24%**	**15 426 386**	**41 005 456**	**17%**	**17 699 198**	**23 306 258**	**10%**
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25%**

Profitability Per Business Level

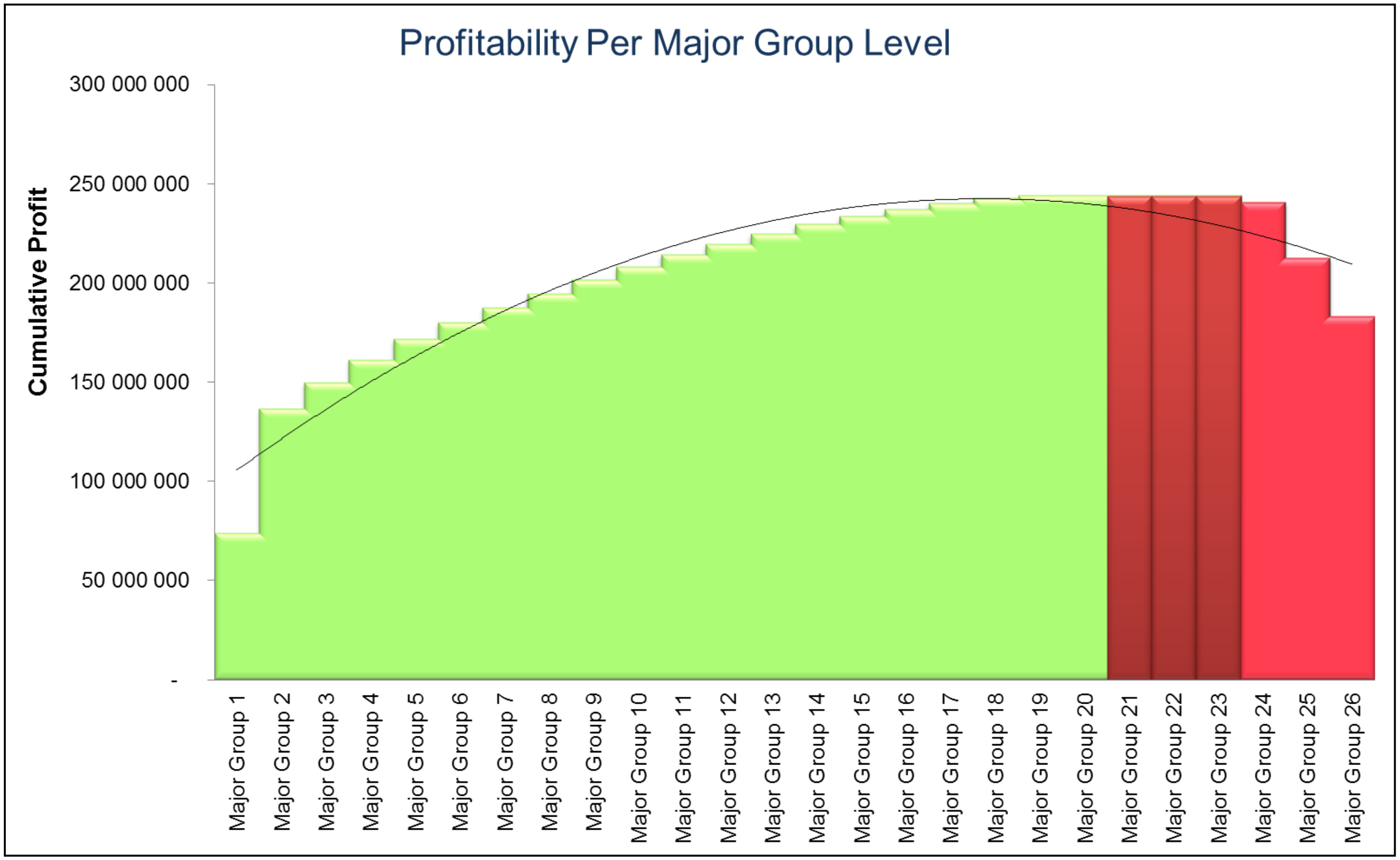
Business Level	Gross Revenue	Discount & Allowances (D&A)	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
Major Group 1	285 216 858	2 006 711	23 004 072	91 837 708	32%	12 224 533	79 613 175	28%	5 591 665	74 021 511	26%	4 692 647
Major Group 2	379 618 716	45 885 101	28 033 819	86 742 993	26%	16 518 649	70 224 344	21%	7 542 104	62 682 240	19%	6 341 013
Major Group 3	413 116 341	47 081 307	38 468 499	45 107 200	12%	25 865 401	19 241 798	5%	6 229 810	13 011 988	4%	9 928 950
Major Group 4	42 365 792	3 532 625	2 662 318	13 879 480	36%	1 753 199	12 126 281	31%	660 313	11 465 968	30%	673 000
Major Group 5	55 654 835	5 384 010	5 365 639	13 799 885	27%	2 304 904	11 494 980	23%	1 017 829	10 477 151	21%	884 783
Major Group 6	28 819 102	1 780 900	1 711 899	10 035 624	37%	1 231 983	8 803 641	33%	501 693	8 301 948	31%	472 921
Major Group 7	33 867 037	7 061 606	1 633 239	9 707 360	36%	1 147 390	8 559 971	32%	910 600	7 649 371	29%	440 448
Major Group 8	452 969 192	119 686 170	34 688 050	36 071 337	11%	20 052 270	16 019 068	5%	9 111 096	6 907 972	2%	7 697 463
Major Group 9	28 752 812	1 279 871	2 679 768	8 564 917	31%	1 186 562	7 378 355	27%	516 805	6 861 550	25%	455 486
Major Group 10	19 459 833	2 680	888 882	8 566 489	44%	1 639 151	6 927 338	36%	338 900	6 588 438	34%	629 221
Major Group 11	32 362 922	2 587 203	3 008 526	8 173 287	27%	1 337 210	6 836 077	23%	609 289	6 226 787	21%	513 315
Major Group 12	332 493 197	105 641 541	7 638 259	29 491 870	13%	14 523 419	14 968 451	7%	9 648 284	5 320 167	2%	5 575 104
Major Group 13	24 094 669	2 074 310	2 340 160	6 482 749	29%	984 924	5 497 824	25%	462 361	5 035 464	23%	378 083
Major Group 14	336 570 020	44 439 453	28 539 461	31 084 852	11%	20 283 962	10 800 890	4%	5 825 191	4 975 699	2%	7 786 403
Major Group 15	25 897 697	2 867 256	2 336 388	5 484 843	24%	1 070 196	4 414 647	19%	505 008	3 909 639	17%	410 820
Major Group 16	14 984 949	139 153	1 264 732	4 418 373	30%	671 934	3 746 439	25%	294 875	3 451 564	23%	257 935
Major Group 17	16 319 349	1 076 857	1 612 627	4 159 242	27%	675 532	3 483 709	23%	289 127	3 194 583	21%	259 317
Major Group 18	6 945 690	18 601	565 997	2 823 355	41%	263 158	2 560 196	37%	103 736	2 456 460	35%	101 018
Major Group 19	2 106 502	238 749	-	1 206 875	65%	-	1 206 875	65%	-	1 206 875	65%	23 534
Major Group 20	198 182	830	13 583	73 543	37%	8 243	65 300	33%	4 049	61 252	31%	3 164
Major Group 21	22 046	361	1 568	8 102	37%	927	7 175	33%	474	6 702	31%	356
Major Group 22	295	-	26	128	43%	11	117	40%	4	113	38%	4
Major Group 23	-	-	-	-	0%	-	-	0%	-	-	0%	-
Major Group 24	5 341 033	4 012 955	575 158	(2 963 111)	-223%	210 227	(3 173 338)	-239%	97 388	(3 270 726)	-246%	80 700
Major Group 25	72 329 155	14 319 994	5 159 820	(19 985 645)	-34%	6 101 618	(26 087 264)	-45%	2 058 661	(28 145 924)	-49%	2 342 228
Major Group 26	353 496 685	117 697 334	30 179 029	(6 872 771)	-3%	15 424 287	(22 297 058)	-9%	7 192 197	(29 489 255)	-13%	5 920 920
Total	2 963 002 909	528 815 580	222 371 522	387 898 685	16%	145 479 691	242 418 994	10%	59 511 457	182 907 537	8%	55 868 835

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
Major Group 1	60.78	0.43	60.35	28.56	31.80	2.65	29.15	4.67	24.47	4.90	19.57	2.61	16.97	1.19	15.77
Major Group 2	59.87	7.24	52.63	29.46	23.17	1.99	21.18	3.08	18.10	4.42	13.68	2.61	11.07	1.19	9.89
Major Group 3	41.61	4.74	36.87	24.71	12.15	1.49	10.66	2.24	8.42	3.87	4.54	2.61	1.94	0.63	1.31
Major Group 4	62.95	5.25	57.70	27.68	30.02	2.02	28.00	3.42	24.58	3.96	20.62	2.61	18.02	0.98	17.04
Major Group 5	62.90	6.09	56.82	28.91	27.91	2.68	25.23	3.57	21.66	6.06	15.60	2.61	12.99	1.15	11.84
Major Group 6	60.94	3.77	57.17	27.10	30.07	1.88	28.19	3.35	24.84	3.62	21.22	2.61	18.62	1.06	17.55
Major Group 7	76.89	16.03	60.86	31.01	29.85	1.09	28.76	3.01	25.75	3.71	22.04	2.61	19.43	2.07	17.37
Major Group 8	58.85	15.55	43.30	28.99	14.31	2.05	12.26	3.07	9.19	4.51	4.69	2.61	2.08	1.18	0.90
Major Group 9	63.13	2.81	60.32	29.20	31.11	2.76	28.36	3.67	24.69	5.88	18.80	2.61	16.20	1.13	15.06
Major Group 10	30.93	0.00	30.92	12.47	18.46	1.47	16.98	1.96	15.03	1.41	13.61	2.61	11.01	0.54	10.47
Major Group 11	63.05	5.04	58.01	29.93	28.07	2.66	25.41	3.63	21.78	5.86	15.92	2.61	13.32	1.19	12.13
Major Group 12	59.64	18.95	40.69	27.71	12.98	0.97	12.02	5.36	6.66	1.37	5.29	2.61	2.68	1.73	0.95
Major Group 13	63.73	5.49	58.24	28.46	29.78	2.69	27.09	3.75	23.34	6.19	17.15	2.61	14.54	1.22	13.32
Major Group 14	43.23	5.71	37.52	25.61	11.91	1.71	10.20	2.54	7.66	3.67	3.99	2.61	1.39	0.75	0.64
Major Group 15	63.04	6.98	56.06	30.95	25.11	2.59	22.51	3.48	19.04	5.69	13.35	2.61	10.75	1.23	9.52
Major Group 16	58.10	0.54	57.56	28.17	29.39	2.48	26.91	4.88	22.03	4.90	17.13	2.61	14.52	1.14	13.38
Major Group 17	62.93	4.15	58.78	30.27	28.51	2.71	25.80	3.55	22.26	6.22	16.04	2.61	13.43	1.11	12.32
Major Group 18	68.76	0.18	68.57	30.26	38.31	2.44	35.87	2.32	33.55	5.60	27.95	2.61	25.34	1.03	24.32
Major Group 19	89.51	10.14	79.36	28.08	51.28	-	51.28	-	51.28	-	51.28	-	51.28	-	51.28
Major Group 20	62.63	0.26	62.37	27.65	34.72	2.32	32.39	4.86	27.54	4.29	23.24	2.61	20.64	1.28	19.36
Major Group 21	61.94	1.01	60.93	26.77	34.16	1.94	32.22	5.05	27.17	4.41	22.76	2.61	20.16	1.33	18.83
Major Group 22	68.66	-	68.66	25.71	42.96	2.97	39.98	4.02	35.96	6.15	29.82	2.61	27.21	0.94	26.27
Major Group 23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major Group 24	66.18	49.73	16.46	34.26	-17.80	2.20	-20.00	9.59	-29.59	7.13	-36.72	2.61	-39.32	1.21	-40.53
Major Group 25	30.88	6.11	24.77	27.30	-2.53	1.54	-4.07	2.26	-6.33	2.20	-8.53	2.61	-11.14	0.88	-12.02
Major Group 26	59.70	19.88	39.82	30.29	9.53	2.61	6.93	2.99	3.94	5.10	-1.16	2.61	-3.77	1.21	-4.98

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
Major Group 1	47%	52%	4%	48%	8%	40%	8%	32%	4%	27.9%	2%	26.0%
Major Group 2	49%	39%	3%	35%	5%	30%	7%	23%	4%	18.5%	2%	16.5%
Major Group 3	59%	29%	4%	26%	5%	20%	9%	11%	6%	4.7%	2%	3.1%
Major Group 4	44%	48%	3%	44%	5%	39%	6%	33%	4%	28.6%	2%	27.1%
Major Group 5	46%	44%	4%	40%	6%	34%	10%	25%	4%	20.7%	2%	18.8%
Major Group 6	44%	49%	3%	46%	6%	41%	6%	35%	4%	30.5%	2%	28.8%
Major Group 7	40%	39%	1%	37%	4%	33%	5%	29%	3%	25.3%	3%	22.6%
Major Group 8	49%	24%	3%	21%	5%	16%	8%	8%	4%	3.5%	2%	1.5%
Major Group 9	46%	49%	4%	45%	6%	39%	9%	30%	4%	25.7%	2%	23.9%
Major Group 10	40%	60%	5%	55%	6%	49%	5%	44%	8%	35.6%	2%	33.9%
Major Group 11	47%	45%	4%	40%	6%	35%	9%	25%	4%	21.1%	2%	19.2%
Major Group 12	46%	22%	2%	20%	9%	11%	2%	9%	4%	4.5%	3%	1.6%
Major Group 13	45%	47%	4%	43%	6%	37%	10%	27%	4%	22.8%	2%	20.9%
Major Group 14	59%	28%	4%	24%	6%	18%	8%	9%	6%	3.2%	2%	1.5%
Major Group 15	49%	40%	4%	36%	6%	30%	9%	21%	4%	17.0%	2%	15.1%
Major Group 16	48%	51%	4%	46%	8%	38%	8%	29%	4%	25.0%	2%	23.0%
Major Group 17	48%	45%	4%	41%	6%	35%	10%	25%	4%	21.3%	2%	19.6%
Major Group 18	44%	56%	4%	52%	3%	49%	8%	41%	4%	36.9%	1%	35.4%
Major Group 19	31%	57%	0%	57%	0%	57%	0%	57%	0%	57.3%	0%	57.3%
Major Group 20	44%	55%	4%	52%	8%	44%	7%	37%	4%	32.9%	2%	30.9%
Major Group 21	43%	55%	3%	52%	8%	44%	7%	37%	4%	32.5%	2%	30.4%
Major Group 22	37%	63%	4%	58%	6%	52%	9%	43%	4%	39.6%	1%	38.3%
Major Group 23	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0%	0.0%
Major Group 24	52%	-27%	3%	-30%	14%	-45%	11%	-55%	4%	-59.4%	2%	-61.2%
Major Group 25	88%	-8%	5%	-13%	7%	-20%	7%	-28%	8%	-36.1%	3%	-38.9%
Major Group 26	51%	16%	4%	12%	5%	7%	9%	-2%	4%	-6.3%	2%	-8.3%


Profitability Per Major Group Level
Cumulative Profit
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
Major Group 1
Major Group 2
Major Group 3
Major Group 4
Major Group 5
Major Group 6
Major Group 7
Major Group 8
Major Group 9
Major Group 10
Major Group 11
Major Group 12
Major Group 13
Major Group 14
Major Group 15
Major Group 16
Major Group 17
Major Group 18
Major Group 19
Major Group 20
Major Group 21
Major Group 22
Major Group 23
Major Group 24
Major Group 25
Major Group 26

11.2.5. CDC & DC Level View – L6

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
CDC 1	535 698 174	95 057 940	440 640 233	237 913 013	202 727 220	46%	8 476 870	194 250 350	44%	31 676 194	162 574 155	37%
DC 1	**77 235 636**	**4 415 529**	**72 820 107**	**32 500 226**	**40 319 881**	**55%**	**2 849 459**	**37 470 422**	**51%**	**4 132 153**	**33 338 269**	**46%**
CDC 2	406 669 014	58 135 345	348 533 669	247 465 418	101 068 252	29%	12 558 608	88 509 644	25%	16 996 969	71 512 675	21%
DC 2	**109 760 727**	**18 487 169**	**91 273 558**	**49 373 789**	**41 899 769**	**46%**	**5 070 661**	**36 829 108**	**40%**	**5 825 006**	**31 004 103**	**34%**
DC 3	73 759 004	9 133 653	64 625 351	31 856 549	32 768 802	51%	3 681 614	29 087 188	45%	4 327 940	24 759 248	38%
DC 4	**336 313 777**	**104 262 687**	**232 051 090**	**152 155 234**	**79 895 856**	**34%**	**6 026 616**	**73 869 240**	**32%**	**30 237 093**	**43 632 147**	**19%**
DC 5	73 860 884	11 840 084	62 020 800	33 940 239	28 080 561	45%	2 938 623	25 141 938	41%	5 252 774	19 889 165	32%
DC 6	**58 587 236**	**7 772 255**	**50 814 982**	**26 541 552**	**24 273 430**	**48%**	**2 483 402**	**21 790 028**	**43%**	**3 810 374**	**17 979 654**	**35%**
DC 7	45 081 095	5 802 458	39 278 637	19 898 330	19 380 307	49%	1 736 334	17 643 973	45%	2 121 301	15 522 672	40%
DC 8	**47 386 288**	**7 006 267**	**40 380 021**	**21 294 278**	**19 085 743**	**47%**	**1 898 607**	**17 187 136**	**43%**	**1 800 397**	**15 386 739**	**38%**
CDC 3	220 428 296	37 179 065	183 249 231	125 717 576	57 531 654	31%	9 835 829	47 695 825	26%	8 340 411	39 355 414	21%
DC 9	**40 781 126**	**4 735 255**	**36 045 871**	**18 163 806**	**17 882 065**	**50%**	**1 893 081**	**15 988 984**	**44%**	**1 780 831**	**14 208 153**	**39%**
DC 10	43 773 961	5 878 106	37 895 855	19 658 896	18 236 959	48%	1 755 282	16 481 676	43%	2 848 091	13 633 585	36%
DC 11	**23 047 965**	**2 741 051**	**20 306 913**	**10 547 859**	**9 759 054**	**48%**	**439 255**	**9 319 800**	**46%**	**1 922 374**	**7 397 426**	**36%**
DC 12	50 463 184	7 400 327	43 062 857	22 879 656	20 183 201	47%	2 750 101	17 433 100	40%	4 240 075	13 193 024	31%
DC 13	**77 696 863**	**14 343 131**	**63 353 732**	**36 245 637**	**27 108 094**	**43%**	**3 534 342**	**23 573 753**	**37%**	**7 229 400**	**16 344 353**	**26%**
DC 14	26 085 876	3 530 949	22 554 927	11 153 392	11 401 535	51%	1 450 737	9 950 798	44%	1 557 924	8 392 874	37%
DC 15	**30 457 469**	**4 313 357**	**26 144 112**	**14 038 445**	**12 105 667**	**46%**	**1 248 985**	**10 856 682**	**42%**	**1 598 687**	**9 257 995**	**35%**
DC 16	20 786 547	2 979 988	17 806 558	9 237 481	8 569 077	48%	528 183	8 040 894	45%	1 217 699	6 823 195	38%
DC 17	**53 574 478**	**5 377 984**	**48 196 494**	**35 323 259**	**12 873 235**	**27%**	**666 026**	**12 207 208**	**25%**	**2 188 972**	**10 018 237**	**21%**
DC 18	53 720 403	9 386 874	44 333 529	26 448 363	17 885 166	40%	2 410 820	15 474 345	35%	3 990 410	11 483 936	26%
DC 19	**37 879 292**	**6 949 780**	**30 929 512**	**18 234 717**	**12 694 795**	**41%**	**1 060 520**	**11 634 275**	**38%**	**2 107 474**	**9 526 801**	**31%**
DC 20	26 173 505	4 005 544	22 167 961	11 889 642	10 278 319	46%	1 016 365	9 261 954	42%	3 182 943	6 079 011	27%
DC 21	**22 792 628**	**3 294 973**	**19 497 655**	**11 498 994**	**7 998 661**	**41%**	**706 021**	**7 292 641**	**37%**	**1 632 764**	**5 659 876**	**29%**
DC 22	70 091	8 113	61 979	29 323	32 655	53%	1 064	31 591	51%	1 179	30 411	49%
DC 23	**16 508 914**	**2 478 287**	**14 030 627**	**8 705 440**	**5 325 187**	**38%**	**319 736**	**5 005 451**	**36%**	**983 344**	**4 022 107**	**29%**
DC 24	13 133 279	2 458 805	10 674 474	7 399 029	3 275 444	31%	715 681	2 559 763	24%	757 637	1 802 127	17%
DC 25	**14 183 788**	**3 076 107**	**11 107 681**	**7 997 173**	**3 110 508**	**28%**	**1 346 444**	**1 764 064**	**16%**	**764 909**	**999 155**	**9%**
DC 26	29 046 748	4 483 948	24 562 799	17 717 655	6 845 144	28%	1 481 116	5 364 028	22%	1 415 168	3 948 860	16%
DC 27	**45 466 399**	**9 552 975**	**35 913 424**	**26 814 395**	**9 099 028**	**25%**	**2 153 840**	**6 945 188**	**19%**	**2 350 423**	**4 594 765**	**13%**
DC 28	47 202 849	9 010 027	38 192 822	28 106 884	10 085 938	26%	3 169 675	6 916 263	18%	4 248 282	2 667 981	7%
DC 29	**42 821 897**	**7 524 672**	**35 297 225**	**26 761 002**	**8 536 223**	**24%**	**3 014 744**	**5 521 479**	**16%**	**2 586 026**	**2 935 452**	**8%**
DC 30	23 085 243	4 750 861	18 334 381	15 551 049	2 783 332	15%	2 136 691	646 641	4%	1 018 781	(372 140)	-2%
DC 31	**58 515 337**	**9 470 999**	**49 044 338**	**37 307 404**	**11 736 934**	**24%**	**3 509 815**	**8 227 119**	**17%**	**3 776 284**	**4 450 835**	**9%**
DC 32	46 375 494	7 980 075	38 395 419	28 842 483	9 552 936	25%	2 804 461	6 748 475	18%	4 236 884	2 511 591	7%
DC 33	**27 506**	**1 876 912**	**(1 849 405)**	**4 611 324**	**(6 460 729)**	**349%**	**206 243**	**(6 666 972)**	**360%**	**137 900**	**(6 804 872)**	**368%**
DC 34	15 081 613	5 156 469	9 925 144	13 571 431	(3 646 287)	-37%	531 355	(4 177 642)	-42%	1 689 941	(5 867 583)	-59%
DC 35	**91 155 043**	**18 441 129**	**72 713 914**	**59 070 732**	**13 643 183**	**19%**	**5 970 248**	**7 672 935**	**11%**	**4 129 290**	**3 543 644**	**5%**
DC 36	28 315 282	8 516 429	19 798 853	32 440 976	(12 642 123)	-64%	1 470 146	(14 112 269)	-71%	1 052 564	(15 164 833)	-77%
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25%**

Profitability Per Business Level

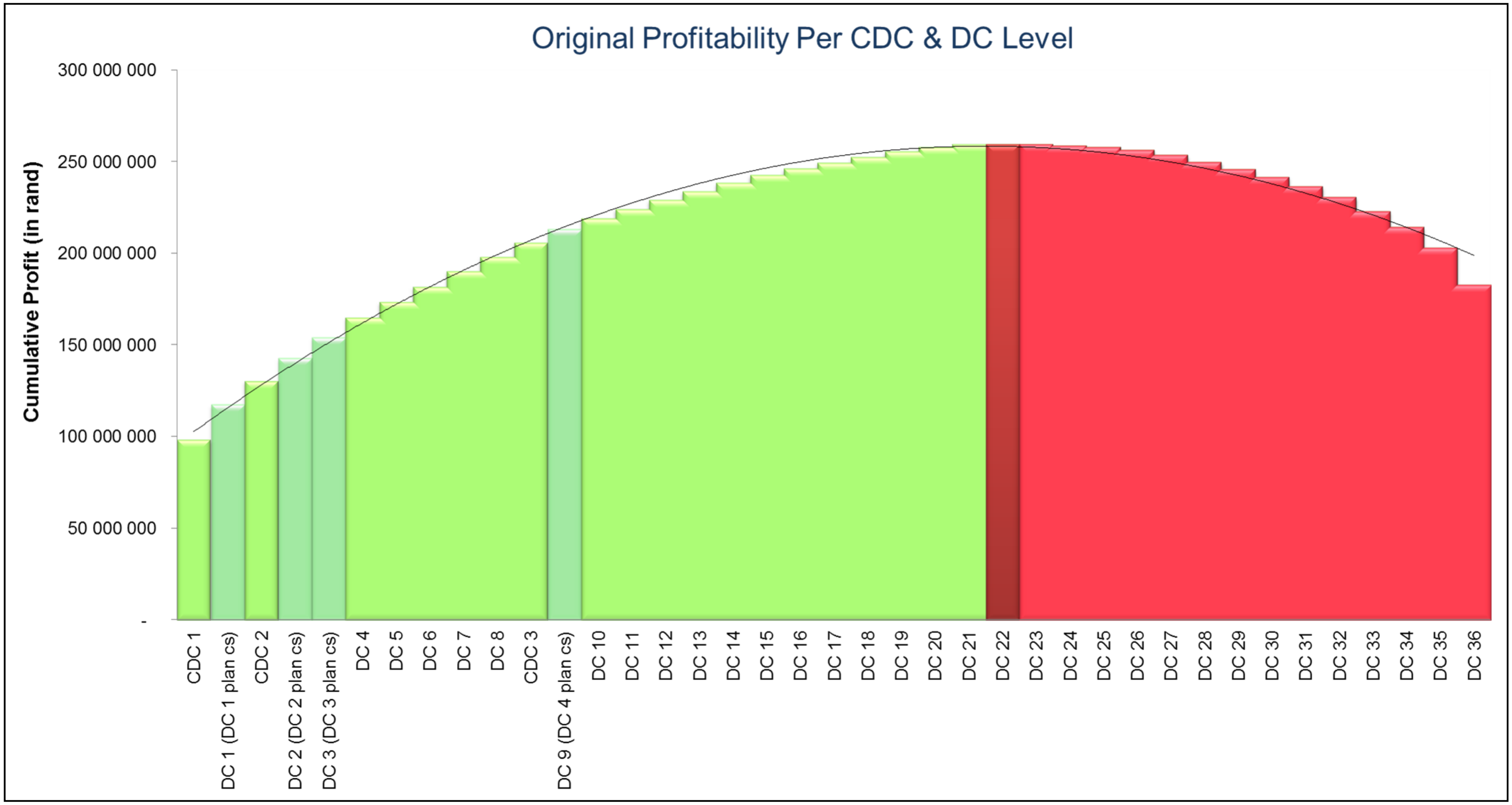
Business Level	Gross Revenue	Discount & Allowances (D&A)	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
CDC 1	535 698 174	95 057 940	29 127 298	133 446 857	30%	24 653 622	108 793 235	25%	10 228 604	98 564 631	22%	9 487 318
DC 1	**77 235 636**	**4 415 529**	**9 438 502**	**23 899 767**	**33%**	**3 237 455**	**20 662 312**	**28%**	**1 514 177**	**19 148 135**	**26%**	**1 242 762**
CDC 2	406 669 014	58 135 345	31 063 357	40 449 318	12%	19 848 071	20 601 247	6%	7 732 249	12 868 997	4%	7 619 078
DC 2	**109 760 727**	**18 487 169**	**11 522 086**	**19 482 016**	**21%**	**4 929 920**	**14 552 096**	**16%**	**2 225 180**	**12 326 916**	**14%**	**1 892 448**
DC 3	73 759 004	9 133 653	8 853 785	15 905 463	25%	3 138 529	12 766 934	20%	1 458 866	11 308 068	17%	1 204 787
DC 4	**336 313 777**	**104 262 687**	**8 398 538**	**35 233 609**	**15%**	**14 681 777**	**20 551 832**	**9%**	**9 649 971**	**10 901 862**	**5%**	**5 635 893**
DC 5	73 860 884	11 840 084	6 268 325	13 620 840	22%	3 542 734	10 078 106	16%	1 600 320	8 477 786	14%	1 359 949
DC 6	**58 587 236**	**7 772 255**	**5 619 622**	**12 360 032**	**24%**	**2 814 165**	**9 545 867**	**19%**	**1 122 160**	**8 423 707**	**17%**	**1 080 273**
DC 7	45 081 095	5 802 458	4 300 273	11 222 399	29%	2 040 256	9 182 144	23%	881 041	8 301 103	21%	783 193
DC 8	**47 386 288**	**7 006 267**	**4 325 470**	**11 061 269**	**27%**	**2 185 784**	**8 875 486**	**22%**	**879 134**	**7 996 352**	**20%**	**839 057**
CDC 3	220 428 296	37 179 065	17 316 084	22 039 330	12%	10 793 386	11 245 944	6%	3 474 568	7 771 376	4%	4 143 273
DC 9	**40 781 126**	**4 735 255**	**4 449 140**	**9 759 013**	**27%**	**1 837 656**	**7 921 357**	**22%**	**769 096**	**7 152 261**	**20%**	**705 421**
DC 10	43 773 961	5 878 106	4 779 402	8 854 183	23%	2 005 180	6 849 003	18%	798 780	6 050 223	16%	769 728
DC 11	**23 047 965**	**2 741 051**	**829 327**	**6 568 099**	**32%**	**1 202 890**	**5 365 209**	**26%**	**319 032**	**5 046 177**	**25%**	**461 753**
DC 12	50 463 184	7 400 327	5 091 192	8 101 832	19%	2 332 508	5 769 324	13%	909 520	4 859 805	11%	895 380
DC 13	**77 696 863**	**14 343 131**	**6 225 585**	**10 118 767**	**16%**	**4 008 417**	**6 110 350**	**10%**	**1 376 607**	**4 733 744**	**7%**	**1 538 711**
DC 14	26 085 876	3 530 949	2 069 147	6 323 727	28%	1 087 907	5 235 820	23%	575 213	4 660 607	21%	417 615
DC 15	**30 457 469**	**4 313 357**	**2 908 033**	**6 349 962**	**24%**	**1 436 873**	**4 913 089**	**19%**	**570 766**	**4 342 323**	**17%**	**551 577**
DC 16	20 786 547	2 979 988	1 985 107	4 838 088	27%	943 861	3 894 227	22%	412 283	3 481 944	20%	362 320
DC 17	**53 574 478**	**5 377 984**	**1 108 394**	**8 909 842**	**18%**	**5 086 489**	**3 823 354**	**8%**	**592 283**	**3 231 070**	**7%**	**1 952 550**
DC 18	53 720 403	9 386 874	4 523 116	6 960 820	16%	3 008 094	3 952 725	9%	826 736	3 125 989	7%	1 154 717
DC 19	**37 879 292**	**6 949 780**	**3 839 022**	**5 687 779**	**18%**	**1 960 457**	**3 727 322**	**12%**	**782 744**	**2 944 578**	**10%**	**752 560**
DC 20	26 173 505	4 005 544	2 001 817	4 077 194	18%	1 199 327	2 877 866	13%	533 662	2 344 204	11%	460 386
DC 21	**22 792 628**	**3 294 973**	**2 564 927**	**3 094 950**	**16%**	**1 195 007**	**1 899 943**	**10%**	**452 060**	**1 447 882**	**7%**	**458 727**
DC 22	70 091	8 113	1 003	29 409	47%	2 970	26 439	43%	1 101	25 338	41%	1 140
DC 23	**16 508 914**	**2 478 287**	**2 907 913**	**1 114 194**	**8%**	**956 690**	**157 503**	**1%**	**221 887**	**(64 383)**	**0%**	**367 245**
DC 24	13 133 279	2 458 805	1 657 315	144 811	1%	564 217	(419 406)	-4%	277 283	(696 688)	-7%	216 586
DC 25	**14 183 788**	**3 076 107**	**973 750**	**25 405**	**0%**	**609 888**	**(584 483)**	**-5%**	**304 758**	**(889 241)**	**-8%**	**234 118**
DC 26	29 046 748	4 483 948	3 309 809	639 051	3%	1 411 666	(772 615)	-3%	596 911	(1 369 526)	-6%	541 896
DC 27	**45 466 399**	**9 552 975**	**4 374 106**	**220 659**	**1%**	**2 361 126**	**(2 140 467)**	**-6%**	**801 658**	**(2 942 125)**	**-8%**	**906 365**
DC 28	47 202 849	9 010 027	3 407 693	(739 712)	-2%	2 357 983	(3 097 695)	-8%	704 382	(3 802 077)	-10%	905 159
DC 29	**42 821 897**	**7 524 672**	**3 741 313**	**(805 861)**	**-2%**	**2 131 686**	**(2 937 547)**	**-8%**	**892 890**	**(3 830 436)**	**-11%**	**818 290**
DC 30	23 085 243	4 750 861	2 275 638	(2 647 778)	-14%	1 126 677	(3 774 455)	-21%	423 073	(4 197 528)	-23%	432 497
DC 31	**58 515 337**	**9 470 999**	**5 448 319**	**(997 484)**	**-2%**	**3 098 153**	**(4 095 637)**	**-8%**	**974 835**	**(5 070 472)**	**-10%**	**1 189 288**
DC 32	46 375 494	7 980 075	5 277 651	(2 766 061)	-7%	2 419 063	(5 185 123)	-14%	736 351	(5 921 474)	-15%	928 605
DC 33	**27 506**	**1 876 912**	**296 184**	**(7 101 055)**	**384%**	**354 615**	**(7 455 670)**	**403%**	**165 796**	**(7 621 466)**	**412%**	**136 126**
DC 34	15 081 613	5 156 469	876 084	(6 743 667)	-68%	1 398 266	(8 141 933)	-82%	568 184	(8 710 117)	-88%	536 752
DC 35	**91 155 043**	**18 441 129**	**7 670 948**	**(4 127 304)**	**-6%**	**4 961 403**	**(9 088 707)**	**-12%**	**2 013 417**	**(11 102 124)**	**-15%**	**1 904 534**
DC 36	28 315 282	8 516 429	1 546 246	(16 711 078)	-84%	2 554 923	(19 266 001)	-97%	1 143 880	(20 409 881)	-103%	980 758
Total	**2 963 002 909**	**528 815 580**	**222 371 522**	**387 898 685**	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
CDC 1	56.46	10.02	46.45	25.08	21.37	0.89	20.47	3.34	17.14	3.07	14.07	2.60	11.47	1.08	10.39
DC 1	62.15	3.55	58.60	26.15	32.44	2.29	30.15	3.32	26.83	7.59	19.23	2.61	16.63	1.22	15.41
CDC 2	53.38	7.63	45.74	32.48	13.27	1.65	11.62	2.23	9.39	4.08	5.31	2.61	2.70	1.01	1.69
DC 2	58.00	9.77	48.23	26.09	22.14	2.68	19.46	3.08	16.38	6.09	10.29	2.61	7.69	1.18	6.51
DC 3	61.22	7.58	53.64	26.44	27.20	3.06	24.14	3.59	20.55	7.35	13.20	2.61	10.60	1.21	9.39
DC 4	59.67	18.50	41.17	27.00	14.18	1.07	13.11	5.37	7.74	1.49	6.25	2.61	3.65	1.71	1.93
DC 5	54.31	8.71	45.61	24.96	20.65	2.16	18.49	3.86	14.62	4.61	10.02	2.61	7.41	1.18	6.23
DC 6	54.23	7.19	47.04	24.57	22.47	2.30	20.17	3.53	16.64	5.20	11.44	2.61	8.84	1.04	7.80
DC 7	57.56	7.41	50.15	25.41	24.75	2.22	22.53	2.71	19.82	5.49	14.33	2.61	11.72	1.12	10.60
DC 8	56.48	8.35	48.13	25.38	22.75	2.26	20.48	2.15	18.34	5.16	13.18	2.61	10.58	1.05	9.53
CDC 3	53.20	8.97	44.23	30.34	13.89	2.37	11.51	2.01	9.50	4.18	5.32	2.61	2.71	0.84	1.88
DC 9	57.81	6.71	51.10	25.75	25.35	2.68	22.67	2.52	20.14	6.31	13.83	2.61	11.23	1.09	10.14
DC 10	56.87	7.64	49.23	25.54	23.69	2.28	21.41	3.70	17.71	6.21	11.50	2.61	8.90	1.04	7.86
DC 11	49.91	5.94	43.98	22.84	21.13	0.95	20.18	4.16	16.02	1.80	14.22	2.61	11.62	0.69	10.93
DC 12	56.36	8.27	48.09	25.55	22.54	3.07	19.47	4.74	14.73	5.69	9.05	2.61	6.44	1.02	5.43
DC 13	50.49	9.32	41.17	23.56	17.62	2.30	15.32	4.70	10.62	4.05	6.58	2.61	3.97	0.89	3.08
DC 14	62.46	8.46	54.01	26.71	27.30	3.47	23.83	3.73	20.10	4.95	15.14	2.61	12.54	1.38	11.16
DC 15	55.22	7.82	47.40	25.45	21.95	2.26	19.68	2.90	16.78	5.27	11.51	2.61	8.91	1.03	7.87
DC 16	57.37	8.22	49.15	25.50	23.65	1.46	22.19	3.36	18.83	5.48	13.35	2.61	10.75	1.14	9.61
DC 17	27.44	2.75	24.68	18.09	6.59	0.34	6.25	1.12	5.13	0.57	4.56	2.61	1.96	0.30	1.65
DC 18	46.52	8.13	38.39	22.90	15.49	2.09	13.40	3.46	9.95	3.92	6.03	2.61	3.42	0.72	2.71
DC 19	50.33	9.23	41.10	24.23	16.87	1.41	15.46	2.80	12.66	5.10	7.56	2.61	4.95	1.04	3.91
DC 20	56.85	8.70	48.15	25.83	22.33	2.21	20.12	6.91	13.20	4.35	8.86	2.61	6.25	1.16	5.09
DC 21	49.69	7.18	42.50	25.07	17.44	1.54	15.90	3.56	12.34	5.59	6.75	2.61	4.14	0.99	3.16
DC 22	61.48	7.12	54.37	25.72	28.65	0.93	27.71	1.03	26.68	0.88	25.80	2.61	23.19	0.97	22.23
DC 23	44.95	6.75	38.21	23.70	14.50	0.87	13.63	2.68	10.95	7.92	3.03	2.61	0.43	0.60	-0.18
DC 24	60.64	11.35	49.29	34.16	15.12	3.30	11.82	3.50	8.32	7.65	0.67	2.61	-1.94	1.28	-3.22
DC 25	60.58	13.14	47.44	34.16	13.29	5.75	7.53	3.27	4.27	4.16	0.11	2.61	-2.50	1.30	-3.80
DC 26	53.60	8.27	45.33	32.70	12.63	2.73	9.90	2.61	7.29	6.11	1.18	2.61	-1.43	1.10	-2.53
DC 27	50.16	10.54	39.62	29.58	10.04	2.38	7.66	2.59	5.07	4.83	0.24	2.61	-2.36	0.88	-3.25
DC 28	52.15	9.95	42.19	31.05	11.14	3.50	7.64	4.69	2.95	3.76	-0.82	2.61	-3.42	0.78	-4.20
DC 29	52.33	9.20	43.14	32.70	10.43	3.68	6.75	3.16	3.59	4.57	-0.98	2.61	-3.59	1.09	-4.68
DC 30	53.38	10.98	42.39	35.96	6.44	4.94	1.50	2.36	-0.86	5.26	-6.12	2.61	-8.73	0.98	-9.71
DC 31	49.20	7.96	41.24	31.37	9.87	2.95	6.92	3.18	3.74	4.58	-0.84	2.61	-3.44	0.82	-4.26
DC 32	49.94	8.59	41.35	31.06	10.29	3.02	7.27	4.56	2.70	5.68	-2.98	2.61	-5.58	0.79	-6.38
DC 33	0.20	13.79	-13.59	33.88	-47.46	1.52	-48.98	1.01	-49.99	2.18	-52.17	2.61	-54.77	1.22	-55.99
DC 34	28.10	9.61	18.49	25.28	-6.79	0.99	-7.78	3.15	-10.93	1.63	-12.56	2.61	-15.17	1.06	-16.23
DC 35	47.86	9.68	38.18	31.02	7.16	3.13	4.03	2.17	1.86	4.03	-2.17	2.61	-4.77	1.06	-5.83
DC 36	28.87	8.68	20.19	33.08	-12.89	1.50	-14.39	1.07	-15.46	1.58	-17.04	2.61	-19.64	1.17	-20.81

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
CDC 1	44%	38%	2%	36%	6%	30%	5%	25%	5%	20.3%	2%	18.4%
DC 1 (DC	42%	52%	4%	49%	5%	43%	12%	31%	4%	26.8%	2%	24.8%
CDC 2	61%	25%	3%	22%	4%	18%	8%	10%	5%	5.1%	2%	3.2%
DC 2 (DC	45%	38%	5%	34%	5%	28%	10%	18%	4%	13.3%	2%	11.2%
DC 3 (DC	43%	44%	5%	39%	6%	34%	12%	22%	4%	17.3%	2%	15.3%
DC 4	45%	24%	2%	22%	9%	13%	2%	10%	4%	6.1%	3%	3.2%
DC 5	46%	38%	4%	34%	7%	27%	8%	18%	5%	13.6%	2%	11.5%
DC 6	45%	41%	4%	37%	7%	31%	10%	21%	5%	16.3%	2%	14.4%
DC 7	44%	43%	4%	39%	5%	34%	10%	25%	5%	20.4%	2%	18.4%
DC 8	45%	40%	4%	36%	4%	32%	9%	23%	5%	18.7%	2%	16.9%
CDC 3	57%	26%	4%	22%	4%	18%	8%	10%	5%	5.1%	2%	3.5%
DC 9 (DC	45%	44%	5%	39%	4%	35%	11%	24%	5%	19.4%	2%	17.5%
DC 10	45%	42%	4%	38%	7%	31%	11%	20%	5%	15.6%	2%	13.8%
DC 11	46%	42%	2%	40%	8%	32%	4%	28%	5%	23.3%	1%	21.9%
DC 12	45%	40%	5%	35%	8%	26%	10%	16%	5%	11.4%	2%	9.6%
DC 13	47%	35%	5%	30%	9%	21%	8%	13%	5%	7.9%	2%	6.1%
DC 14	43%	44%	6%	38%	6%	32%	8%	24%	4%	20.1%	2%	17.9%
DC 15	46%	40%	4%	36%	5%	30%	10%	21%	5%	16.1%	2%	14.3%
DC 16	44%	41%	3%	39%	6%	33%	10%	23%	5%	18.7%	2%	16.8%
DC 17	66%	24%	1%	23%	4%	19%	2%	17%	9%	7.1%	1%	6.0%
DC 18	49%	33%	4%	29%	7%	21%	8%	13%	6%	7.4%	2%	5.8%
DC 19	48%	34%	3%	31%	6%	25%	10%	15%	5%	9.8%	2%	7.8%
DC 20	45%	39%	4%	35%	12%	23%	8%	16%	5%	11.0%	2%	9.0%
DC 21	50%	35%	3%	32%	7%	25%	11%	14%	5%	8.3%	2%	6.4%
DC 22	42%	47%	2%	45%	2%	43%	1%	42%	4%	37.7%	2%	36.1%
DC 23	53%	32%	2%	30%	6%	24%	18%	7%	6%	1.0%	1%	-0.4%
DC 24	56%	25%	5%	19%	6%	14%	13%	1%	4%	-3.2%	2%	-5.3%
DC 25	56%	22%	9%	12%	5%	7%	7%	0%	4%	-4.1%	2%	-6.3%
DC 26	61%	24%	5%	18%	5%	14%	11%	2%	5%	-2.7%	2%	-4.7%
DC 27	59%	20%	5%	15%	5%	10%	10%	0%	5%	-4.7%	2%	-6.5%
DC 28	60%	21%	7%	15%	9%	6%	7%	-2%	5%	-6.6%	1%	-8.1%
DC 29	62%	20%	7%	13%	6%	7%	9%	-2%	5%	-6.9%	2%	-8.9%
DC 30	67%	12%	9%	3%	4%	-2%	10%	-11%	5%	-16.4%	2%	-18.2%
DC 31	64%	20%	6%	14%	6%	8%	9%	-2%	5%	-7.0%	2%	-8.7%
DC 32	62%	21%	6%	15%	9%	5%	11%	-6%	5%	-11.2%	2%	-12.8%
DC 33	16765%	-23488%	750%	-24238%	501%	-24739%	1077%	-25816%	1289%	-27105.4%	603%	-27708.1%
DC 34	90%	-24%	4%	-28%	11%	-39%	6%	-45%	9%	-54.0%	4%	-57.8%
DC 35	65%	15%	7%	8%	5%	4%	8%	-5%	5%	-10.0%	2%	-12.2%
DC 36	115%	-45%	5%	-50%	4%	-54%	5%	-59%	9%	-68.0%	4%	-72.1%


Original Profitability Per CDC & DC Level
Cumulative Profit (in rand)
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
CDC 1
DC 1 (DC 1 plan cs)
CDC 2
DC 2 (DC 2 plan cs)
DC 3 (DC 3 plan cs)
DC 4
DC 5
DC 6
DC 7
DC 8
CDC 3
DC 9 (DC 4 plan cs)
DC 10
DC 11
DC 12
DC 13
DC 14
DC 15
DC 16
DC 17
DC 18
DC 19
DC 20
DC 21
DC 22
DC 23
DC 24
DC 25
DC 26
DC 27
DC 28
DC 29
DC 30
DC 31
DC 32
DC 33
DC 34
DC 35
DC 36

11.2.6. Item Brand Level View – L7

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
Item Brand 1	672 679 156	139 624 953	533 054 203	295 553 725	237 500 478	45%	18 022 015	219 478 463	41%	31 964 879	187 513 584	35%
Item Brand 2	322 916 210	54 175 888	268 740 322	143 548 211	125 192 111	47%	10 197 116	114 994 994	43%	18 811 364	96 183 630	36%
Item Brand 3	972 994 257	180 344 111	792 650 146	519 314 671	273 335 475	34%	34 590 247	238 745 228	30%	58 716 428	180 028 800	23%
Item Brand 4	37 360 410	7 608 616	29 751 794	16 754 967	12 996 827	44%	829 224	12 167 602	41%	1 260 190	10 907 413	37%
Item Brand 5	19 459 833	2 681	19 457 152	7 844 586	11 612 566	60%	926 957	10 685 609	55%	1 230 239	9 455 370	49%
Item Brand 6	23 169 256	3 669 820	19 499 436	9 576 498	9 922 939	51%	726 731	9 196 207	47%	798 808	8 397 399	43%
Item Brand 7	6 471 563	862 794	5 608 770	37 981	5 570 788	99%	601 274	4 969 514	89%	555 690	4 413 825	79%
Item Brand 8	25 790 975	3 970 503	21 820 473	14 271 710	7 548 762	35%	835 439	6 713 323	31%	1 386 507	5 326 816	24%
Item Brand 9	4 409 050	1 117 879	3 291 171	2 034 844	1 256 327	38%	104 239	1 152 088	35%	119 518	1 032 570	31%
Item Brand 10	3 510 588	566 502	2 944 085	1 565 343	1 378 742	47%	112 240	1 266 502	43%	179 114	1 087 388	37%
Item Brand 11	4 980 050	1 329 600	3 650 449	2 793 497	856 952	23%	130 701	726 251	20%	203 750	522 502	14%
Item Brand 12	8 836 114	1 376 750	7 459 364	6 812 663	646 701	9%	128 560	518 141	7%	173 430	344 711	5%
Item Brand 13	11 038	9 243	1 795	-	1 795	100%	-	1 795	100%	-	1 795	100%
Item Brand 14	-	924	(924)	61	(984)	107%	7	(991)	107%	5	(996)	108%
Item Brand 15	-	7 020	(7 020)	-	(7 020)	100%	-	(7 020)	100%	-	(7 020)	100%
Item Brand 16	10 673	16 252	(5 580)	5 206	(10 785)	193%	314	(11 099)	199%	577	(11 676)	209%
Item Brand 17	5 448	13 559	(8 111)	3 921	(12 032)	148%	426	(12 458)	154%	590	(13 048)	161%
Item Brand 18	482 450	91 784	390 667	348 696	41 971	11%	20 357	21 614	6%	36 275	(14 661)	-4%
Item Brand 19	326 391	86 057	240 334	1 546	238 788	99%	25 132	213 656	89%	24 160	189 497	79%
Item Brand 20	12 582	11 066	1 516	35	1 481	98%	190	1 291	85%	719	572	38%
Item Brand 21	5 762 942	967 872	4 795 069	4 250 583	544 486	11%	276 636	267 851	6%	420 166	(152 316)	-3%
Item Brand 22	37 141 024	6 584 848	30 556 176	22 168 094	8 388 082	27%	1 909 794	6 478 288	21%	2 402 167	4 076 120	13%
Item Brand 23	130 306 475	18 132 219	112 174 256	77 168 391	35 005 865	31%	7 270 624	27 735 241	25%	9 360 987	18 374 254	16%
Item Brand 24	15 010 433	2 303 441	12 706 992	10 709 765	1 997 227	16%	946 221	1 051 006	8%	1 466 009	(415 003)	-3%
Item Brand 25	115 766 646	19 921 090	95 845 556	74 190 307	21 655 249	23%	5 449 023	16 206 226	17%	7 485 277	8 720 948	9%
Item Brand 26	555 589 345	86 020 107	469 569 238	329 947 351	139 621 887	30%	22 744 134	116 877 753	25%	42 570 019	74 307 735	16%
Total	2 963 002 909	528 815 580	2 434 187 330	1 538 902 653	895 284 677	37%	105 847 602	789 437 075	32%	179 166 868	610 270 207	25%

Profitability Per Business Level

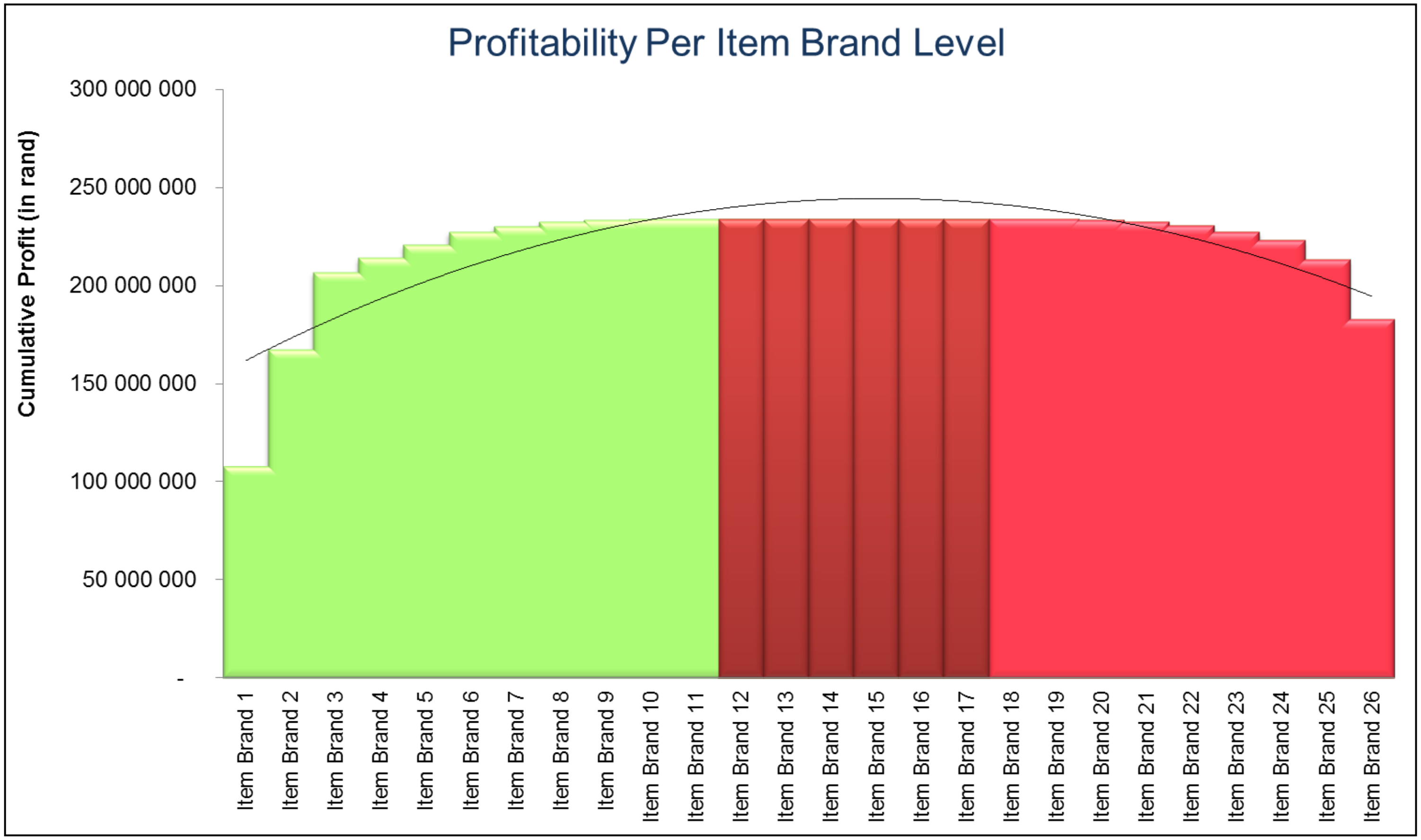
Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
Item Brand 1	672 679 156	139 624 953	533 054 203	36 569 282	150 944 302	28%	23 620 141	127 324 160	24%	19 320 654	108 003 506	20%	9 067 062
Item Brand 2	322 916 210	54 175 888	268 740 322	22 727 124	73 456 506	27%	13 561 685	59 894 821	22%	836 800	59 058 021	22%	5 205 923
Item Brand 3	972 994 257	180 344 111	792 650 146	65 597 326	114 431 474	14%	41 226 278	73 205 196	9%	33 534 618	39 670 579	5%	15 849 062
Item Brand 4	37 360 410	7 608 616	29 751 794	1 892 216	9 015 196	30%	1 054 220	7 960 976	27%	837 113	7 123 863	24%	404 683
Item Brand 5	19 459 833	2 681	19 457 152	888 882	8 566 488	44%	1 639 151	6 927 337	36%	338 900	6 588 437	34%	629 221
Item Brand 6	23 169 256	3 669 820	19 499 436	1 184 801	7 212 598	37%	698 834	6 513 764	33%	36 641	6 477 123	33%	268 262
Item Brand 7	6 471 563	862 794	5 608 770	856 591	3 557 234	63%	589 599	2 967 634	53%	29 236	2 938 399	52%	226 329
Item Brand 8	25 790 975	3 970 503	21 820 473	1 859 780	3 467 036	16%	1 102 567	2 364 468	11%	66 076	2 298 392	11%	423 242
Item Brand 9	4 409 050	1 117 879	3 291 171	144 241	888 329	27%	93 800	794 529	24%	4 651	789 878	24%	36 007
Item Brand 10	3 510 588	566 502	2 944 085	260 506	826 882	28%	140 514	686 368	23%	111 794	574 574	20%	53 939
Item Brand 11	4 980 050	1 329 600	3 650 449	253 073	269 429	7%	153 545	115 883	3%	7 739	108 144	3%	58 941
Item Brand 12	8 836 114	1 376 750	7 459 364	207 048	137 663	2%	112 263	25 400	0%	5 567	19 833	0%	43 094
Item Brand 13	11 038	9 243	1 795	-	1 795	100%	-	1 795	100%	-	1 795	100%	22
Item Brand 14	-	924	(924)	11	(1 007)	109%	6	(1 013)	110%	0	(1 013)	110%	2
Item Brand 15	-	7 020	(7 020)	-	(7 020)	100%	-	(7 020)	100%	-	(7 020)	100%	-
Item Brand 16	10 673	16 252	(5 580)	756	(12 432)	223%	481	(12 913)	231%	24	(12 937)	232%	185
Item Brand 17	5 448	13 559	(8 111)	613	(13 661)	168%	413	(14 075)	174%	20	(14 095)	174%	159
Item Brand 18	482 450	91 784	390 667	47 187	(61 849)	-16%	24 100	(85 949)	-22%	1 198	(87 146)	-22%	9 251
Item Brand 19	326 391	86 057	240 334	252 206	(62 709)	-26%	24 000	(86 708)	-36%	1 194	(87 903)	-37%	9 213
Item Brand 20	12 582	11 066	1 516	282 072	(281 500)	-18569%	549	(282 048)	-18605%	27	(282 075)	-18607%	211
Item Brand 21	5 762 942	967 872	4 795 069	637 932	(790 247)	-16%	330 592	(1 120 840)	-23%	17 918	(1 138 758)	-24%	126 904
Item Brand 22	37 141 024	6 584 848	30 556 176	3 532 335	543 785	2%	2 221 868	(1 678 083)	-5%	136 097	(1 814 179)	-6%	852 908
Item Brand 23	130 306 475	18 132 219	112 174 256	13 181 902	5 192 352	5%	8 088 465	(2 896 113)	-3%	426 867	(3 322 980)	-3%	3 104 919
Item Brand 24	15 010 433	2 303 441	12 706 992	1 985 799	(2 400 802)	-19%	1 356 336	(3 757 138)	-30%	93 967	(3 851 105)	-30%	520 656
Item Brand 25	115 766 646	19 921 090	95 845 556	11 224 216	(2 503 268)	-3%	7 099 078	(9 602 346)	-10%	505 774	(10 108 120)	-11%	2 725 123
Item Brand 26	555 589 345	86 020 107	469 569 238	58 785 623	15 522 112	3%	42 341 206	(26 819 094)	-6%	3 198 582	(30 017 676)	-6%	16 253 516
Total	2 963 002 909	528 815 580	2 434 187 330	222 371 522	387 898 685	16%	145 479 691	242 418 994	10%	59 511 457	182 907 537	8%	55 868 835

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M)	GP6
Item Brand 1	74.19	15.40	58.79	32.60	26.19	1.99	24.21	3.53	20.68	4.03	16.65	2.61	14.04	2.13	11.91
Item Brand 2	**62.03**	**10.41**	**51.62**	**27.57**	**24.05**	**1.96**	**22.09**	**3.61**	**18.48**	**4.37**	**14.11**	**2.61**	**11.51**	**0.16**	**11.34**
Item Brand 3	61.39	11.38	50.01	32.77	17.25	2.18	15.06	3.70	11.36	4.14	7.22	2.60	4.62	2.12	2.50
Item Brand 4	**92.32**	**18.80**	**73.52**	**41.40**	**32.12**	**2.05**	**30.07**	**3.11**	**26.95**	**4.68**	**22.28**	**2.61**	**19.67**	**2.07**	**17.60**
Item Brand 5	30.93	0.00	30.92	12.47	18.46	1.47	16.98	1.96	15.03	1.41	13.61	2.61	11.01	0.54	10.47
Item Brand 6	**86.37**	**13.68**	**72.69**	**35.70**	**36.99**	**2.71**	**34.28**	**2.98**	**31.30**	**4.42**	**26.89**	**2.61**	**24.28**	**0.14**	**24.14**
Item Brand 7	28.59	3.81	24.78	0.17	24.61	2.66	21.96	2.46	19.50	3.78	15.72	2.61	13.11	0.13	12.98
Item Brand 8	**60.94**	**9.38**	**51.56**	**33.72**	**17.84**	**1.97**	**15.86**	**3.28**	**12.59**	**4.39**	**8.19**	**2.61**	**5.59**	**0.16**	**5.43**
Item Brand 9	122.45	31.05	91.40	56.51	34.89	2.89	32.00	3.32	28.68	4.01	24.67	2.61	22.07	0.13	21.94
Item Brand 10	**65.08**	**10.50**	**54.58**	**29.02**	**25.56**	**2.08**	**23.48**	**3.32**	**20.16**	**4.83**	**15.33**	**2.61**	**12.72**	**2.07**	**10.65**
Item Brand 11	84.49	22.56	61.93	47.39	14.54	2.22	12.32	3.46	8.86	4.29	4.57	2.61	1.97	0.13	1.83
Item Brand 12	**205.04**	**31.95**	**173.09**	**158.09**	**15.01**	**2.98**	**12.02**	**4.02**	**8.00**	**4.80**	**3.19**	**2.61**	**0.59**	**0.13**	**0.46**
Item Brand 13	511.02	427.90	83.12	-	83.12	-	83.12	-	83.12	-	83.12	-	83.12	-	83.12
Item Brand 14	**-**	**427.60**	**-427.60**	**28.08**	**-455.68**	**3.21**	**-458.89**	**2.41**	**-461.30**	**4.90**	**-466.20**	**2.61**	**-468.81**	**0.13**	**-468.93**
Item Brand 15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Item Brand 16	**57.77**	**87.97**	**-30.20**	**28.18**	**-58.38**	**1.70**	**-60.08**	**3.12**	**-63.20**	**4.09**	**-67.30**	**2.61**	**-69.90**	**0.13**	**-70.03**
Item Brand 17	34.34	85.47	-51.13	24.71	-75.84	2.68	-78.53	3.72	-82.25	3.86	-86.11	2.61	-88.72	0.13	-88.85
Item Brand 18	**52.15**	**9.92**	**42.23**	**37.69**	**4.54**	**2.20**	**2.34**	**3.92**	**-1.58**	**5.10**	**-6.69**	**2.61**	**-9.29**	**0.13**	**-9.42**
Item Brand 19	35.43	9.34	26.09	0.17	25.92	2.73	23.19	2.62	20.57	27.38	-6.81	2.61	-9.41	0.13	-9.54
Item Brand 20	**59.74**	**52.55**	**7.20**	**0.17**	**7.03**	**0.90**	**6.13**	**3.41**	**2.72**	**1 339.37**	**-1 336.66**	**2.61**	**-1 339.26**	**0.13**	**-1 339.39**
Item Brand 21	45.41	7.63	37.78	33.49	4.29	2.18	2.11	3.31	-1.20	5.03	-6.23	2.61	-8.83	0.14	-8.97
Item Brand 22	**43.55**	**7.72**	**35.83**	**25.99**	**9.83**	**2.24**	**7.60**	**2.82**	**4.78**	**4.14**	**0.64**	**2.61**	**-1.97**	**0.16**	**-2.13**
Item Brand 23	41.97	5.84	36.13	24.85	11.27	2.34	8.93	3.01	5.92	4.25	1.67	2.61	-0.93	0.14	-1.07
Item Brand 24	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Item Brand 25	42.48	7.31	35.17	27.22	7.95	2.00	5.95	2.75	3.20	4.12	-0.92	2.61	-3.52	0.19	-3.71
Item Brand 26	**34.18**	**5.29**	**28.89**	**20.30**	**8.59**	**1.40**	**7.19**	**2.62**	**4.57**	**3.62**	**0.96**	**2.61**	**-1.65**	**0.20**	**-1.85**

Unit Rate % Of Gross Sales

Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing	GP6%
Item Brand 1	44%	35%	3%	33%	5%	28%	5%	22%	4%	18.9%	3%	16.1%
Item Brand 2	44%	39%	3%	36%	6%	30%	7%	23%	4%	18.5%	0%	18.3%
Item Brand 3	53%	28%	4%	25%	6%	19%	7%	12%	4%	7.5%	3%	4.1%
Item Brand 4	45%	35%	2%	33%	3%	29%	5%	24%	3%	21.3%	2%	19.1%
Item Brand 5	40%	60%	5%	55%	6%	49%	5%	44%	8%	35.6%	2%	33.9%
Item Brand 6	41%	43%	3%	40%	3%	36%	5%	31%	3%	28.1%	0%	28.0%
Item Brand 7	1%	86%	9%	77%	9%	68%	13%	55%	9%	45.9%	0%	45.4%
Item Brand 8	55%	29%	3%	26%	5%	21%	7%	13%	4%	9.2%	0%	8.9%
Item Brand 9	46%	28%	2%	26%	3%	23%	3%	20%	2%	18.0%	0%	17.9%
Item Brand 10	45%	39%	3%	36%	5%	31%	7%	24%	4%	19.6%	3%	16.4%
Item Brand 11	56%	17%	3%	15%	4%	10%	5%	5%	3%	2.3%	0%	2.2%
Item Brand 12	77%	7%	1%	6%	2%	4%	2%	2%	1%	0.3%	0%	0.2%
Item Brand 13	0%	16%	0%	16%	0%	16%	0%	16%	0%	16.3%	0%	16.3%
Item Brand 14	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Item Brand 15	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Item Brand 16	49%	-101%	3%	-104%	5%	-109%	7%	-116%	5%	-121.0%	0%	-121.2%
Item Brand 17	72%	-221%	8%	-229%	11%	-240%	11%	-251%	8%	-258.3%	0%	-258.7%
Item Brand 18	72%	9%	4%	4%	8%	-3%	10%	-13%	5%	-17.8%	0%	-18.1%
Item Brand 19	0%	73%	8%	65%	7%	58%	77%	-19%	7%	-26.6%	0%	-26.9%
Item Brand 20	0%	12%	2%	10%	6%	5%	2242%	-2237%	4%	-2241.6%	0%	-2241.9%
Item Brand 21	74%	9%	5%	5%	7%	-3%	11%	-14%	6%	-19.4%	0%	-19.8%
Item Brand 22	60%	23%	5%	17%	6%	11%	10%	1%	6%	-4.5%	0%	-4.9%
Item Brand 23	59%	27%	6%	21%	7%	14%	10%	4%	6%	-2.2%	0%	-2.6%
Item Brand 24	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0%	0.0%
Item Brand 25	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0%	0.0%
Item Brand 26	59%	25%	4%	21%	8%	13%	11%	3%	8%	-4.8%	1%	-5.4%


Profitability Per Item Brand Level
Cumulative Profit (in rand)
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
Item Brand 1
Item Brand 2
Item Brand 3
Item Brand 4
Item Brand 5
Item Brand 6
Item Brand 7
Item Brand 8
Item Brand 9
Item Brand 10
Item Brand 11
Item Brand 12
Item Brand 13
Item Brand 14
Item Brand 15
Item Brand 16
Item Brand 17
Item Brand 18
Item Brand 19
Item Brand 20
Item Brand 21
Item Brand 22
Item Brand 23
Item Brand 24
Item Brand 25
Item Brand 26

11.2.7. Extra Item Brand Level View – L8

Profitability Per Business Level

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	GP1%	Storage	GP2	G2%	Delivery	GP3	GP3%
Item Brand 1	672 679 156	139 624 953	533 054 203	295 553 725	237 500 478	45%	18 022 015	219 478 463	41%	31 964 879	187 513 584	35%
Item Brand 2	**322 916 210**	**54 175 888**	**268 740 322**	**143 548 211**	**125 192 111**	**47%**	**10 197 116**	**114 994 994**	**43%**	**18 811 364**	**96 183 630**	**36%**
Item Brand 3	970 887 755	180 105 362	790 782 393	518 653 793	272 128 600	34%	34 590 247	237 538 353	30%	58 716 428	178 821 925	23%
Item Brand Other 1	**262 969 109**	**49 324 233**	**213 644 877**	**113 770 843**	**99 874 034**	**47%**	**10 755 572**	**89 118 462**	**42%**	**19 070 213**	**70 048 249**	**33%**
Item Brand 4	37 360 410	7 608 616	29 751 794	16 754 967	12 996 827	44%	829 224	12 167 602	41%	1 260 190	10 907 413	37%
Item Brand 5	**19 459 833**	**2 681**	**19 457 152**	**7 844 586**	**11 612 566**	**60%**	**926 957**	**10 685 609**	**55%**	**1 230 239**	**9 455 370**	**49%**
Item Brand 6	23 169 256	3 669 820	19 499 436	9 576 498	9 922 939	51%	726 731	9 196 207	47%	798 808	8 397 399	43%
Item Brand 7	**6 471 563**	**862 794**	**5 608 770**	**37 981**	**5 570 788**	**99%**	**601 274**	**4 969 514**	**89%**	**555 690**	**4 413 825**	**79%**
Item Brand 8	25 790 975	3 970 503	21 820 473	14 271 710	7 548 762	35%	835 439	6 713 323	31%	1 386 507	5 326 816	24%
Item Brand 9	**2 106 502**	**238 749**	**1 867 753**	**660 878**	**1 206 875**	**65%**	**-**	**1 206 875**	**65%**	**-**	**1 206 875**	**65%**
Item Brand 10	4 409 050	1 117 879	3 291 171	2 034 844	1 256 327	38%	104 239	1 152 088	35%	119 518	1 032 570	31%
Item Brand 11	**3 510 588**	**566 502**	**2 944 085**	**1 565 343**	**1 378 742**	**47%**	**112 240**	**1 266 502**	**43%**	**179 114**	**1 087 388**	**37%**
Item Brand 12	4 980 050	1 329 600	3 650 449	2 793 497	856 952	23%	130 701	726 251	20%	203 750	522 502	14%
Item Brand 13	**8 836 114**	**1 376 750**	**7 459 364**	**6 812 663**	**646 701**	**9%**	**128 560**	**518 141**	**7%**	**173 430**	**344 711**	**5%**
Item Brand 14	11 038	9 243	1 795	-	1 795	100%	-	1 795	100%	-	1 795	100%
Item Brand 15	**-**	**924**	**(924)**	**61**	**(984)**	**107%**	**7**	**(991)**	**107%**	**5**	**(996)**	**108%**
Item Brand 16	-	7 020	(7 020)	-	(7 020)	100%	-	(7 020)	100%	-	(7 020)	100%
Item Brand 17	**10 673**	**16 252**	**(5 580)**	**5 206**	**(10 785)**	**193%**	**314**	**(11 099)**	**199%**	**577**	**(11 676)**	**209%**
Item Brand 18	5 448	13 559	(8 111)	3 921	(12 032)	148%	426	(12 458)	154%	590	(13 048)	161%
Item Brand 19	**482 450**	**91 784**	**390 667**	**348 696**	**41 971**	**11%**	**20 357**	**21 614**	**6%**	**36 275**	**(14 661)**	**-4%**
Item Brand 20	326 391	86 057	240 334	1 546	238 788	99%	25 132	213 656	89%	24 160	189 497	79%
Item Brand 21	**12 582**	**11 066**	**1 516**	**35**	**1 481**	**98%**	**190**	**1 291**	**85%**	**719**	**572**	**38%**
Item Brand 22	1 720 284	285 729	1 434 555	1 585 304	(150 750)	-11%	148 726	(299 476)	-21%	166 690	(466 166)	-32%
Item Brand 23	**5 762 942**	**967 872**	**4 795 069**	**4 250 583**	**544 486**	**11%**	**276 636**	**267 851**	**6%**	**420 166**	**(152 316)**	**-3%**
Item Brand 24	37 141 024	6 584 848	30 556 176	22 168 094	8 388 082	27%	1 909 794	6 478 288	21%	2 402 167	4 076 120	13%
Item Brand 25	**13 290 149**	**2 017 712**	**11 272 437**	**9 124 461**	**2 147 976**	**19%**	**797 495**	**1 350 482**	**12%**	**1 299 319**	**51 163**	**0%**
Item Brand 26	130 306 475	18 132 219	112 174 256	77 168 391	35 005 865	31%	7 270 624	27 735 241	25%	9 360 987	18 374 254	16%
Item Brand 27	**115 766 646**	**19 921 090**	**95 845 556**	**74 190 307**	**21 655 249**	**23%**	**5 449 023**	**16 206 226**	**17%**	**7 485 277**	**8 720 948**	**9%**
Item Brand Other 2	292 620 236	36 695 875	255 924 361	216 176 508	39 747 854	16%	11 988 562	27 759 292	11%	23 499 806	4 259 486	2%
Total	**2 963 002 909**	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**37%**	**105 847 602**	**789 437 075**	**32%**	**179 166 868**	**610 270 207**	**25%**

Profitability Per Business Level

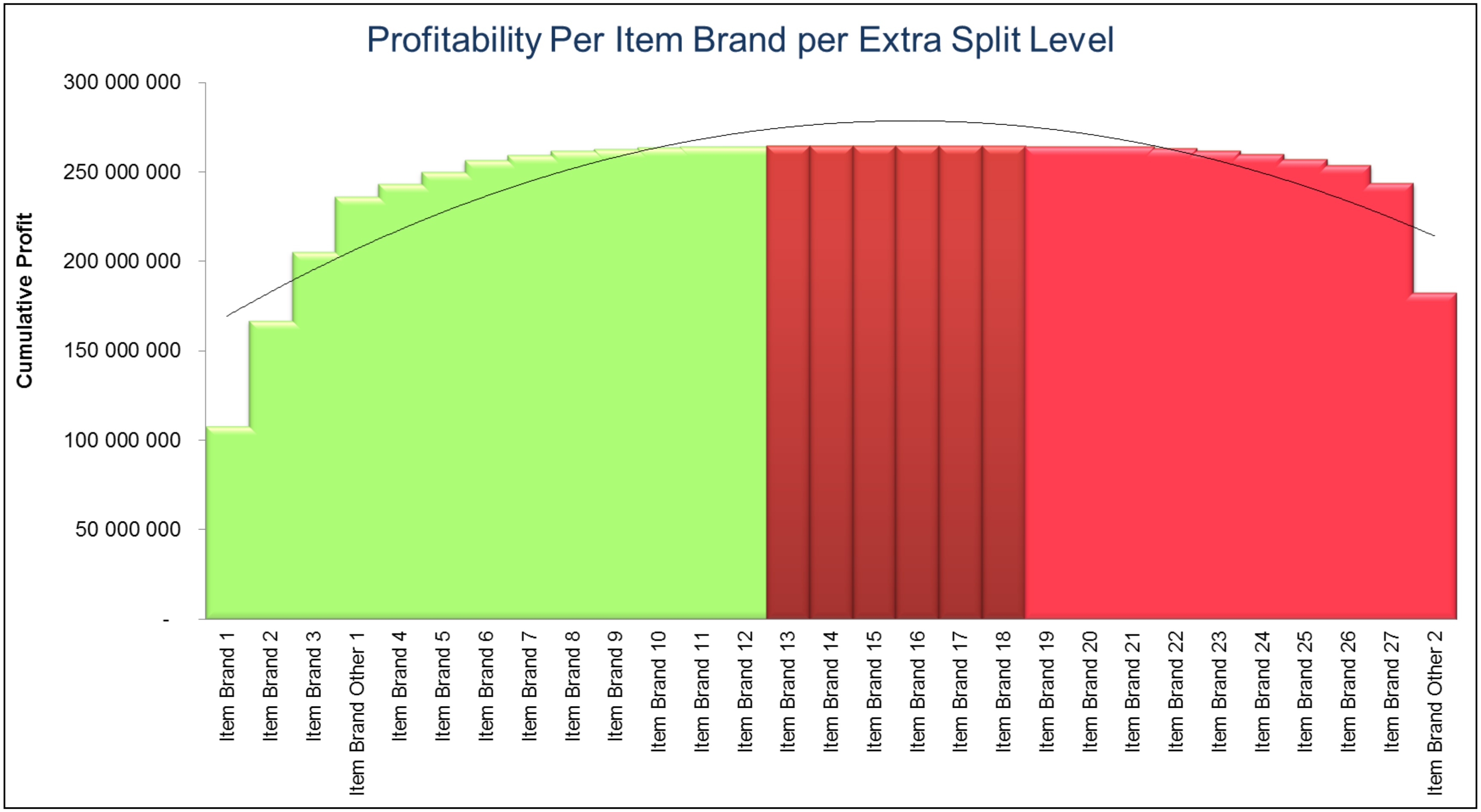
Business Level	Gross Revenue	Discount & Allowances (D&A)	Sales & Marketing	GP4	GP4%	Admin Overheads	GP5	GP5%	Advertising & Marketing (A&M)	GP6	GP6%	Invoice Sales Volume (kg)
Item Brand 1	672 679 156	139 624 953	36 569 282	150 944 302	28%	23 620 141	127 324 160	24%	19 320 654	108 003 506	20%	9 067 062
Item Brand 2	**322 916 210**	**54 175 888**	**22 727 124**	**73 456 506**	**27%**	**13 561 685**	**59 894 821**	**22%**	**836 800**	**59 058 021**	**22%**	**5 205 923**
Item Brand 3	970 887 755	180 105 362	65 597 326	113 224 599	14%	41 226 278	71 998 321	9%	33 534 618	38 463 704	5%	15 825 529
Item Brand Other 1	**262 969 109**	**49 324 233**	**24 040 740**	**46 007 509**	**22%**	**14 206 129**	**31 801 380**	**15%**	**799 404**	**31 001 977**	**15%**	**5 453 306**
Item Brand 4	37 360 410	7 608 616	1 892 216	9 015 196	30%	1 054 220	7 960 976	27%	837 113	7 123 863	24%	404 683
Item Brand 5	**19 459 833**	**2 681**	**888 882**	**8 566 488**	**44%**	**1 639 151**	**6 927 337**	**36%**	**338 900**	**6 588 437**	**34%**	**629 221**
Item Brand 6	23 169 256	3 669 820	1 184 801	7 212 598	37%	698 834	6 513 764	33%	36 641	6 477 123	33%	268 262
Item Brand 7	**6 471 563**	**862 794**	**856 591**	**3 557 234**	**63%**	**589 599**	**2 967 634**	**53%**	**29 236**	**2 938 399**	**52%**	**226 329**
Item Brand 8	25 790 975	3 970 503	1 859 780	3 467 036	16%	1 102 567	2 364 468	11%	66 076	2 298 392	11%	423 242
Item Brand 9	**2 106 502**	**238 749**	**-**	**1 206 875**	**65%**	**-**	**1 206 875**	**65%**	**-**	**1 206 875**	**65%**	**23 534**
Item Brand 10	4 409 050	1 117 879	144 241	888 329	27%	93 800	794 529	24%	4 651	789 878	24%	36 007
Item Brand 11	**3 510 588**	**566 502**	**260 506**	**826 882**	**28%**	**140 514**	**686 368**	**23%**	**111 794**	**574 574**	**20%**	**53 939**
Item Brand 12	4 980 050	1 329 600	253 073	269 429	7%	153 545	115 883	3%	7 739	108 144	3%	58 941
Item Brand 13	**8 836 114**	**1 376 750**	**207 048**	**137 663**	**2%**	**112 263**	**25 400**	**0%**	**5 567**	**19 833**	**0%**	**43 094**
Item Brand 14	11 038	9 243	-	1 795	100%	-	1 795	100%	-	1 795	100%	22
Item Brand 15	**-**	**924**	**11**	**(1 007)**	**109%**	**6**	**(1 013)**	**110%**	**0**	**(1 013)**	**110%**	**2**
Item Brand 16	-	7 020	-	(7 020)	100%	-	(7 020)	100%	-	(7 020)	100%	-
Item Brand 17	**10 673**	**16 252**	**756**	**(12 432)**	**223%**	**481**	**(12 913)**	**231%**	**24**	**(12 937)**	**232%**	**185**
Item Brand 18	5 448	13 559	613	(13 661)	168%	413	(14 075)	174%	20	(14 095)	174%	159
Item Brand 19	**482 450**	**91 784**	**47 187**	**(61 849)**	**-16%**	**24 100**	**(85 949)**	**-22%**	**1 198**	**(87 146)**	**-22%**	**9 251**
Item Brand 20	326 391	86 057	252 206	(62 709)	-26%	24 000	(86 708)	-36%	1 194	(87 903)	-37%	9 213
Item Brand 21	**12 582**	**11 066**	**282 072**	**(281 500)**	**-18569%**	**549**	**(282 048)**	**-18605%**	**27**	**(282 075)**	**-18607%**	**211**
Item Brand 22	1 720 284	285 729	254 898	(721 065)	-50%	177 261	(898 326)	-63%	9 450	(907 776)	-63%	68 045
Item Brand 23	**5 762 942**	**967 872**	**637 932**	**(790 247)**	**-16%**	**330 592**	**(1 120 840)**	**-23%**	**17 918**	**(1 138 758)**	**-24%**	**126 904**
Item Brand 24	37 141 024	6 584 848	3 532 335	543 785	2%	2 221 868	(1 678 083)	-5%	136 097	(1 814 179)	-6%	852 908
Item Brand 25	**13 290 149**	**2 017 712**	**1 730 901**	**(1 679 737)**	**-15%**	**1 179 075**	**(2 858 812)**	**-25%**	**84 517**	**(2 943 329)**	**-26%**	**452 611**
Item Brand 26	130 306 475	18 132 219	13 181 902	5 192 352	5%	8 088 465	(2 896 113)	-3%	426 867	(3 322 980)	-3%	3 104 919
Item Brand 27	**115 766 646**	**19 921 090**	**11 224 216**	**(2 503 268)**	**-3%**	**7 099 078**	**(9 602 346)**	**-10%**	**505 774**	**(10 108 120)**	**-11%**	**2 725 123**
Item Brand Other 2	292 620 236	36 695 875	34 744 883	(30 485 397)	-12%	28 135 077	(58 620 475)	-23%	2 399 178	(61 019 653)	-24%	10 800 210
Total	**2 963 002 909**	**528 815 580**	**222 371 522**	**387 898 685**	**16%**	**145 479 691**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**

Unit Rate (R/kg)

Business Level	Gross Revenue	Discount & Allowances (D&A)	Net Revenue	Cost of Goods Sold	GP1	Storage	GP2	Delivery	GP3	Sales & Marketing	GP4	Admin Overheads	GP5	Advertising & Marketing (A&M	GP6
Item Brand 1	74.19	15.40	58.79	32.60	26.19	1.99	24.21	3.53	20.68	4.03	16.65	2.61	14.04	2.13	11.91
Item Brand 2	**62.03**	**10.41**	**51.62**	**27.57**	**24.05**	**1.96**	**22.09**	**3.61**	**18.48**	**4.37**	**14.11**	**2.61**	**11.51**	**0.16**	**11.34**
Item Brand 3	61.35	11.38	49.97	32.77	17.20	2.19	15.01	3.71	11.30	4.15	7.15	2.61	4.55	2.12	2.43
Item Brand Other 1	**48.22**	**9.04**	**39.18**	**20.86**	**18.31**	**1.97**	**16.34**	**3.50**	**12.85**	**4.41**	**8.44**	**2.61**	**5.83**	**0.15**	**5.68**
Item Brand 4	92.32	18.80	73.52	41.40	32.12	2.05	30.07	3.11	26.95	4.68	22.28	2.61	19.67	2.07	17.60
Item Brand 5	**30.93**	**0.00**	**30.92**	**12.47**	**18.46**	**1.47**	**16.98**	**1.96**	**15.03**	**1.41**	**13.61**	**2.61**	**11.01**	**0.54**	**10.47**
Item Brand 6	86.37	13.68	72.69	35.70	36.99	2.71	34.28	2.98	31.30	4.42	26.89	2.61	24.28	0.14	24.14
Item Brand 7	**28.59**	**3.81**	**24.78**	**0.17**	**24.61**	**2.66**	**21.96**	**2.46**	**19.50**	**3.78**	**15.72**	**2.61**	**13.11**	**0.13**	**12.98**
Item Brand 8	60.94	9.38	51.56	33.72	17.84	1.97	15.86	3.28	12.59	4.39	8.19	2.61	5.59	0.16	5.43
Item Brand 9	**89.51**	**10.14**	**79.36**	**28.08**	**51.28**	**-**	**51.28**	**-**	**51.28**	**-**	**51.28**	**-**	**51.28**	**-**	**51.28**
Item Brand 10	122.45	31.05	91.40	56.51	34.89	2.89	32.00	3.32	28.68	4.01	24.67	2.61	22.07	0.13	21.94
Item Brand 11	**65.08**	**10.50**	**54.58**	**29.02**	**25.56**	**2.08**	**23.48**	**3.32**	**20.16**	**4.83**	**15.33**	**2.61**	**12.72**	**2.07**	**10.65**
Item Brand 12	84.49	22.56	61.93	47.39	14.54	2.22	12.32	3.46	8.86	4.29	4.57	2.61	1.97	0.13	1.83
Item Brand 13	**205.04**	**31.95**	**173.09**	**158.09**	**15.01**	**2.98**	**12.02**	**4.02**	**8.00**	**4.80**	**3.19**	**2.61**	**0.59**	**0.13**	**0.46**
Item Brand 14	511.02	427.90	83.12	-	83.12	-	83.12	-	83.12	-	83.12	-	83.12	-	83.12
Item Brand 15	**-**	**427.60**	**-427.60**	**28.08**	**-455.68**	**3.21**	**-458.89**	**2.41**	**-461.30**	**4.90**	**-466.20**	**2.61**	**-468.81**	**0.13**	**-468.93**
Item Brand 16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Item Brand 17	**57.77**	**87.97**	**-30.20**	**28.18**	**-58.38**	**1.70**	**-60.08**	**3.12**	**-63.20**	**4.09**	**-67.30**	**2.61**	**-69.90**	**0.13**	**-70.03**
Item Brand 18	34.34	85.47	-51.13	24.71	-75.84	2.68	-78.53	3.72	-82.25	3.86	-86.11	2.61	-88.72	0.13	-88.85
Item Brand 19	**52.15**	**9.92**	**42.23**	**37.69**	**4.54**	**2.20**	**2.34**	**3.92**	**-1.58**	**5.10**	**-6.69**	**2.61**	**-9.29**	**0.13**	**-9.42**
Item Brand 20	35.43	9.34	26.09	0.17	25.92	2.73	23.19	2.62	20.57	27.38	-6.81	2.61	-9.41	0.13	-9.54
Item Brand 21	**59.74**	**52.55**	**7.20**	**0.17**	**7.03**	**0.90**	**6.13**	**3.41**	**2.72**	**1 339.37**	**-1 336.66**	**2.61**	**-1 339.26**	**0.13**	**-1 339.39**
Item Brand 22	25.28	4.20	21.08	23.30	-2.22	2.19	-4.40	2.45	-6.85	3.75	-10.60	2.61	-13.20	0.14	-13.34
Item Brand 23	**45.41**	**7.63**	**37.78**	**33.49**	**4.29**	**2.18**	**2.11**	**3.31**	**-1.20**	**5.03**	**-6.23**	**2.61**	**-8.83**	**0.14**	**-8.97**
Item Brand 24	43.55	7.72	35.83	25.99	9.83	2.24	7.60	2.82	4.78	4.14	0.64	2.61	-1.97	0.16	-2.13
Item Brand 25	**29.36**	**4.46**	**24.91**	**20.16**	**4.75**	**1.76**	**2.98**	**2.87**	**0.11**	**3.82**	**-3.71**	**2.61**	**-6.32**	**0.19**	**-6.50**
Item Brand 26	41.97	5.84	36.13	24.85	11.27	2.34	8.93	3.01	5.92	4.25	1.67	2.61	-0.93	0.14	-1.07
Item Brand 27	**42.48**	**7.31**	**35.17**	**27.22**	**7.95**	**2.00**	**5.95**	**2.75**	**3.20**	**4.12**	**-0.92**	**2.61**	**-3.52**	**0.19**	**-3.71**
Item Brand Other 2	27.09	3.40	23.70	20.02	3.68	1.11	2.57	2.18	0.39	3.22	-2.82	2.61	-5.43	0.22	-5.65

Unit Rate % Of Gross Sales

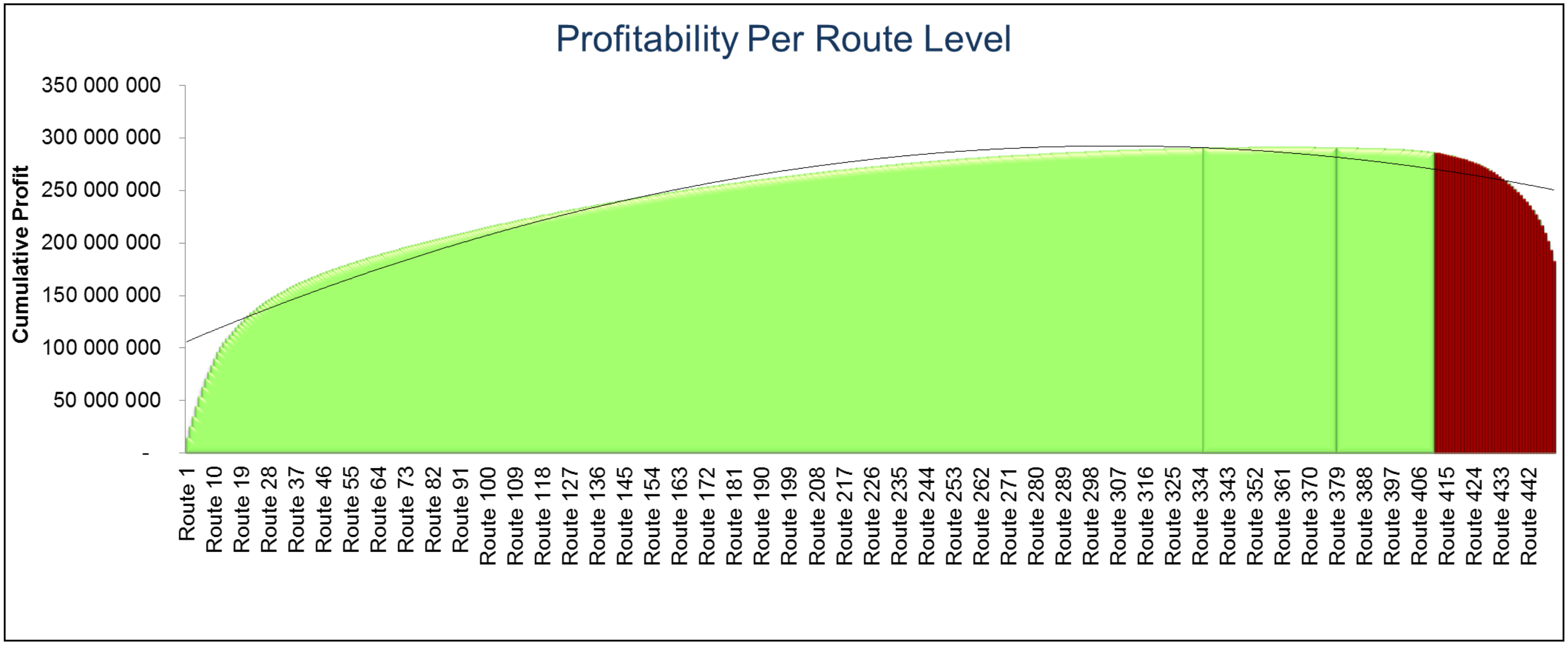
Product Channel	Cost Of Sale	GP1 (%)	Storage	GP2%	Delivery	GP3%	Sales & Marketing	GP4%	Admin Overheads	GP5%	Advertising & Marketing (A&M)	GP6%
Item Brand 1	44%	35%	3%	33%	5%	28%	5%	22%	4%	18.9%	3%	16.1%
Item Brand 2	44%	39%	3%	36%	6%	30%	7%	23%	4%	18.5%	0%	18.3%
Item Brand 3	53%	28%	4%	24%	6%	18%	7%	12%	4%	7.4%	3%	4.0%
Item Brand Other 1	43%	38%	4%	34%	7%	27%	9%	17%	5%	12.1%	0%	11.8%
Item Brand 4	45%	35%	2%	33%	3%	29%	5%	24%	3%	21.3%	2%	19.1%
Item Brand 5	40%	60%	5%	55%	6%	49%	5%	44%	8%	35.6%	2%	33.9%
Item Brand 6	41%	43%	3%	40%	3%	36%	5%	31%	3%	28.1%	0%	28.0%
Item Brand 7	1%	86%	9%	77%	9%	68%	13%	55%	9%	45.9%	0%	45.4%
Item Brand 8	55%	29%	3%	26%	5%	21%	7%	13%	4%	9.2%	0%	8.9%
Item Brand 9	31%	57%	0%	57%	0%	57%	0%	57%	0%	57.3%	0%	57.3%
Item Brand 10	46%	28%	2%	26%	3%	23%	3%	20%	2%	18.0%	0%	17.9%
Item Brand 11	45%	39%	3%	36%	5%	31%	7%	24%	4%	19.6%	3%	16.4%
Item Brand 12	56%	17%	3%	15%	4%	10%	5%	5%	3%	2.3%	0%	2.2%
Item Brand 13	77%	7%	1%	6%	2%	4%	2%	2%	1%	0.3%	0%	0.2%
Item Brand 14	0%	16%	0%	16%	0%	16%	0%	16%	0%	16.3%	0%	16.3%
Item Brand 15	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0%	0.0%
Item Brand 16	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0%	0.0%
Item Brand 17	49%	-101%	3%	-104%	5%	-109%	7%	-116%	5%	-121.0%	0%	-121.2%
Item Brand 18	72%	-221%	8%	-229%	11%	-240%	11%	-251%	8%	-258.3%	0%	-258.7%
Item Brand 19	72%	9%	4%	4%	8%	-3%	10%	-13%	5%	-17.8%	0%	-18.1%
Item Brand 20	0%	73%	8%	65%	7%	58%	77%	-19%	7%	-26.6%	0%	-26.9%
Item Brand 21	0%	12%	2%	10%	6%	5%	2242%	-2237%	4%	-2241.6%	0%	-2241.9%
Item Brand 22	92%	-9%	9%	-17%	10%	-27%	15%	-42%	10%	-52.2%	1%	-52.8%
Item Brand 23	74%	9%	5%	5%	7%	-3%	11%	-14%	6%	-19.4%	0%	-19.8%
Item Brand 24	60%	23%	5%	17%	6%	11%	10%	1%	6%	-4.5%	0%	-4.9%
Item Brand 25	69%	16%	6%	10%	10%	0%	13%	-13%	9%	-21.5%	1%	-22.1%
Item Brand 26	59%	27%	6%	21%	7%	14%	10%	4%	6%	-2.2%	0%	-2.6%
Item Brand 27	64%	19%	5%	14%	6%	8%	10%	-2%	6%	-8.3%	0%	-8.7%
Item Brand Other 2	74%	14%	4%	9%	8%	1%	12%	-10%	10%	-20.0%	1%	-20.9%


Profitability Per Item Brand per Extra Split Level
Cumulative Profit
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
Item Brand 1
Item Brand 2
Item Brand 3
Item Brand Other 1
Item Brand 4
Item Brand 5
Item Brand 6
Item Brand 7
Item Brand 8
Item Brand 9
Item Brand 10
Item Brand 11
Item Brand 12
Item Brand 13
Item Brand 14
Item Brand 15
Item Brand 16
Item Brand 17
Item Brand 18
Item Brand 19
Item Brand 20
Item Brand 21
Item Brand 22
Item Brand 23
Item Brand 24
Item Brand 25
Item Brand 26
Item Brand 27
Item Brand Other 2

11.2.8. Route Level View – L9

Largest to Smallest GP6

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP2	GP2%	Delivery	GP3	GP3%	Sales & Marketing
Route 1	84 201 069	11 085 613	73 115 456	39 843 997	33 271 459	46%	1 498 066	31 773 393	43%	5 640 882	26 132 511	36%	4 654 009
Route 2	55 799 442	6 955 876	48 843 566	26 821 455	22 022 111	45%	925 008	21 097 103	43%	3 740 110	17 356 993	36%	3 160 765
Route 3	35 273 949	5 980 236	29 293 713	13 926 541	15 367 172	52%	449 149	14 918 023	51%	1 687 792	13 230 231	45%	1 481 851
Route 4	36 041 534	4 186 755	31 854 779	15 651 792	16 202 987	51%	548 937	15 654 051	49%	2 015 142	13 638 909	43%	1 948 775
Route 5	36 640 621	2 912 394	33 728 227	16 713 008	17 015 218	50%	649 986	16 365 232	49%	2 421 951	13 943 281	41%	1 955 862
Route 6	33 107 920	3 424 573	29 683 347	14 505 612	15 177 736	51%	513 693	14 664 043	49%	1 877 957	12 786 086	43%	1 810 144
Route 7	30 046 363	3 536 764	26 509 599	12 985 053	13 524 545	51%	457 462	13 067 084	49%	1 680 512	11 386 572	43%	1 623 770
Route 8	19 459 833	2 680	19 457 152	7 844 586	11 612 566	60%	926 957	10 685 609	55%	1 230 239	9 455 370	49%	888 882
Route 9	25 082 384	2 904 758	22 177 626	10 885 219	11 292 407	51%	383 099	10 909 308	49%	1 408 302	9 501 006	43%	1 362 247
Route 10	75 067 085	17 580 605	57 486 480	34 404 539	23 081 941	40%	916 310	22 165 630	39%	8 335 380	13 830 250	24%	2 016 894
Route 11	14 453 063	1 585 391	12 867 672	4 943 020	7 924 652	62%	248 862	7 675 789	60%	399 692	7 276 097	57%	736 754
Route 12	22 173 261	2 631 727	19 541 534	10 138 766	9 402 768	48%	421 467	8 981 301	46%	1 837 638	7 143 662	37%	787 074
Route 13	132 130 404	28 701 697	103 428 707	73 340 059	30 088 648	29%	3 519 975	26 568 673	26%	4 052 693	22 515 980	22%	9 616 742
Route 14	33 997 606	8 946 207	25 051 399	14 786 794	10 264 605	41%	528 694	9 735 911	39%	1 941 781	7 794 130	31%	1 883 960
Route 15	15 109 353	2 063 966	13 045 386	6 945 084	6 100 302	47%	272 202	5 828 100	45%	865 112	4 962 988	38%	343 319
Route 16	27 858 968	3 997 287	23 861 680	16 726 670	7 135 010	30%	745 754	6 389 256	27%	534 182	5 855 074	25%	625 147
Route 17	53 574 478	5 377 984	48 196 494	35 323 259	12 873 235	27%	666 026	12 207 208	25%	2 188 972	10 018 237	21%	1 108 394
Route 18	30 195 890	8 164 423	22 031 467	13 197 463	8 834 004	40%	476 782	8 357 222	38%	1 745 682	6 611 540	30%	1 693 576
Route 19	17 458 621	3 513 236	13 945 385	7 621 590	6 323 795	45%	270 181	6 053 614	43%	991 089	5 062 526	36%	959 783
Route 20	27 523 168	7 349 611	20 173 557	11 969 174	8 204 383	41%	431 018	7 773 366	39%	1 583 542	6 189 824	31%	1 534 856
Route 21	27 154 229	7 364 762	19 789 466	11 791 100	7 998 366	40%	418 634	7 579 732	38%	1 540 733	6 038 999	31%	1 496 519
Route 22	28 785 279	6 092 799	22 692 480	13 305 753	9 386 728	41%	1 140 529	8 246 198	36%	952 244	7 293 954	32%	2 823 979
Route 23	13 644 335	1 550 430	12 093 905	5 889 181	6 204 724	51%	520 077	5 684 647	47%	542 697	5 141 949	43%	1 775 593
Route 24	48 742 019	9 957 488	38 784 532	23 322 935	15 461 597	40%	1 980 655	13 480 942	35%	3 151 958	10 328 983	27%	4 486 292
Route 25	15 200 925	2 911 515	12 289 410	6 544 072	5 745 339	47%	624 677	5 120 662	42%	571 148	4 549 514	37%	1 416 654
Route 26	29 436 236	5 692 587	23 743 650	13 678 480	10 065 170	42%	1 184 021	8 881 149	37%	1 654 034	7 227 115	30%	3 037 044
Route 27	9 404 333	1 243 932	8 160 401	3 969 526	4 190 875	51%	419 220	3 771 656	46%	422 046	3 349 610	41%	920 971
Route 28	7 207 798	629 759	6 578 038	2 982 293	3 595 745	55%	268 260	3 327 485	51%	470 592	2 856 893	43%	555 381
Route 29	10 195 418	988 100	9 207 318	4 628 412	4 578 905	50%	491 788	4 087 118	44%	604 672	3 482 446	38%	979 845
Route 30	20 165 246	3 624 083	16 541 163	9 274 018	7 267 145	44%	985 428	6 281 717	38%	763 803	5 517 914	33%	2 413 675
Route 31	17 532 012	5 007 272	12 524 740	7 414 555	5 110 184	41%	266 360	4 843 824	39%	988 659	3 855 165	31%	960 637
Route 32	3 440 240	365 728	3 074 512	989 274	2 085 238	68%	58 290	2 026 947	66%	63 300	1 963 647	64%	131 784
Route 33	12 483 666	1 327 302	11 156 363	5 764 878	5 391 485	48%	655 582	4 735 903	42%	597 065	4 138 838	37%	1 633 621
Route 34	25 184 360	4 952 488	20 231 872	11 629 320	8 602 552	43%	1 005 335	7 597 217	38%	1 454 705	6 142 512	30%	2 952 348
Route 35	14 286 033	2 878 076	11 407 958	6 417 508	4 990 450	44%	378 099	4 612 351	40%	725 455	3 886 896	34%	1 464 260
Route 36	15 631 236	4 440 229	11 191 006	6 796 485	4 394 522	39%	236 182	4 158 339	37%	868 913	3 289 426	29%	844 782
Route 37	4 434 269	98 425	4 335 844	1 787 889	2 547 955	59%	157 209	2 390 746	55%	180 884	2 209 862	51%	495 672



Profitability Per Route Level
Cumulative Profit
350 000 000
300 000 000
250 000 000
200 000 000
150 000 000
100 000 000
50 000 000
-
Route 1
Route 10
Route 19
Route 28
Route 37
Route 46
Route 55
Route 64
Route 73
Route 82
Route 91
Route 100
Route 109
Route 118
Route 127
Route 136
Route 145
Route 154
Route 163
Route 172
Route 181
Route 190
Route 199
Route 208
Route 217
Route 226
Route 235
Route 244
Route 253
Route 262
Route 271
Route 280
Route 289
Route 298
Route 307
Route 316
Route 325
Route 334
Route 343
Route 352
Route 361
Route 370
Route 379
Route 388
Route 397
Route 406
Route 415
Route 424
Route 433
Route 442

12. Appendix F

12.1 Case Study Green Business Profitability Framework: *Plan*
12.1.1 Current DC detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	122	14	3 839.3	20	8.71	1 625.8	116.1
Tuesday	109	13	4 033.5	20	8.38	902.0	69.4
Wednesday	127	14	7 534.4	20	9.07	1 089.6	77.8
Thursday	140	13	6 951.1	20	10.77	915.4	70.4
Friday	128	14	4 667.1	20	9.14	1 305.0	93.2
	626	**68**			**9.21**	**5 838**	**85.85**

Current DC 2 detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	192	20	4 252.6	25	9.6	2 942.6	147.1
Tuesday	225	14	7 300.7	25	16.1	4 040.4	288.6
Wednesday	238	26	5 773.3	25	9.2	4 158.3	159.9
Thursday	228	27	7 944.5	25	8.4	4 901.3	181.5
Friday	195	20	4 075.8	25	9.8	2 313.2	115.7
	1 078	**107**			**10.07**	**18 356**	**171.55**

Current DC 3 detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	67	8	3 844.3	9	8.40	1 212.1	151.5
Tuesday	83	9	2 648.6	9	9.20	1 285.2	142.8
Wednesday	69	8	3 776.4	9	8.60	1 004.0	125.5
Thursday	73	10	1 865.8	9	7.30	2 183.9	218.4
Friday	47	6	3 858	9	7.80	1 105.9	184.3
	339	**41**			**8.27**	**6 791**	**165.64**

Current DC 4 detail

12.1.2 Optimised and Impact DC detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	135	13	4 691.4	10	10.38	1 079.0	83.0
Tuesday	116	11	4 913.1	10	10.55	782.6	71.1
Wednesday	153	13	5 398.2	10	11.77	1 156.5	89.0
Thursday	148	14	5 702.2	10	10.57	887.2	63.4
Friday	146	17	5 471.7	10	8.59	1 474.5	86.7
	698	**68**			**10.26**	**5 880**	**86.47**

DC 2 Optimisation Detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	-13	1	-852	10	-2	547	33
Tuesday	-7	2	-880	10	-2	119	-2
Wednesday	-26	1	2 136	10	-3	-67	-11
Thursday	-8	-1	1 249	10	0	28	7
Friday	-18	-3	-805	10	1	-169	6
	-72	**-**			**-5.78**	**458**	**34**

DC 2 Impact Detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	179	19	4 587.4	31	9.40	2 359.0	124.2
Tuesday	227	24	5 086.9	31	9.50	3 279.9	136.7
Wednesday	240	25	6 121.1	31	9.60	3 797.3	151.9
Thursday	235	24	7 964.1	31	9.80	3 996.7	166.5
Friday	197	22	3 895.1	31	9.00	2 555.5	116.2
	1 078	**114**			**9.46**	**15 988**	**140.25**

DC 3 Optimisation Detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	13	1	-335	-6	0	584	23
Tuesday	-2	-10	2 214	-6	7	761	152
Wednesday	-2	1	-348	-6	-0	361	8
Thursday	-7	3	-20	-6	-1	905	15
Friday	-2	-2	181	-6	1	-242	-1
	-	**-7**			**5.72**	**2 367**	**197**

DC 3 Impact Detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	74	9	5 623.6	10	8.20	1 317.3	146.4
Tuesday	84	8	5 086.9	10	10.50	874.2	109.3
Wednesday	70	8	3 918.8	10	8.80	1 102.5	137.8
Thursday	77	9	1 945.8	10	8.60	1 237.2	137.5
Friday	53	8	3 943.1	10	6.60	1 021.4	127.7
	358	**42**			**8.52**	**5 552.60**	**132.20**

DC 4 Optimisation Detail

Weekday	Drops	Vehicles	Weight	Base Fleet	Average drops/vehicle	Km	Average Km/vehicle
Monday	-7	-1	-1 779	-1	0	-105	5
Tuesday	-1	1	-2 438	-1	-1	411	34
Wednesday	-1	-	-142	-1	-0	-99	-12
Thursday	-4	1	-80	-1	-1	947	81
Friday	-6	-2	-85	-1	1	85	57
	-19	**-1**			**-1.40**	**1 239**	**164**

DC 4 Impact Detail

12.1.3 Carbon Emissions Impact:

DC 1:	
Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually by DC 1	774 264
Kilometres travelled Proposed annually by DC 1	494 666
Kilometres reduction annually	279 599
Current carbon emissions (tons) annually	193.6
Proposed carbon emissions (tons) annually	123.7
Carbon emission reduction (tons) annually	69.9
% Carbon emission reduction	**36%**
DC 2:	
Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on one return trip per DC per week to the CDC)*	303 566
Kilometres travelled Proposed annually *(based on one return trip per DC per week to the CDC)*	305 750
Kilometres reduction annually	-2 184
Current carbon emissions (tons) annually	75.89
Proposed carbon emissions (tons) annually	76.43
Carbon emission reduction (tons) annually	-0.55
% Carbon emission reduction	**-1%**
DC 3:	
Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on one return trip per DC per week to the CDC)*	954 502
Kilometres travelled Proposed annually *(based on one return trip per DC per week to the CDC)*	831 397
Kilometres reduction annually	123 105
Current carbon emissions (tons) annually	238.6
Proposed carbon emissions (tons) annually	207.8
Carbon emission reduction (tons) annually	30.8
% Carbon emission reduction	**13%**
DC 4:	
Carbon emission conversion:	
kgCO2e per kilometre	0.24999
Kilometres travelled As-Is annually *(based on one return trip per DC per week to the CDC)*	353 137
Kilometres travelled Proposed annually *(based on one return trip per DC per week to the CDC)*	288 735
Kilometres reduction annually	64 402
Current carbon emissions (tons) annually	88.3
Proposed carbon emissions (tons) annually	72.2
Carbon emission reduction (tons) annually	16.1
% Carbon emission reduction	**18%**

Plan Case Study – Carbon Emission Reduction per DC

13. Appendix G

13.1.1 Case Study Green Business Profitability Framework: *Make*

As-Is Cost

**Largest to Smallest GP6*

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	811 288 102	37.08%
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	83 996 575	34.10%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	36.78%

Make Scenario Modelling

With COGS sold reduction

**Largest to Smallest GP6*

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 150 881	811 727 641	37.10%
Business Level 2	351 953 029	105 644 221	246 308 808	161 249 012	85 059 796	34.53%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 537 399 893**	**896 787 437**	**36.84%**

Difference in GP1	**0.06%**

Make Case Study per Business Level– GP1 impact of 0.06 percent

As-Is Cost

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 590 420	220 523 204	10%	49 524 273	170 998 932	7.82%	49 664 510	27 016 594
Business Level 2	351 953 029	105 644 221	246 308 808	162 312 233	21 895 789	9%	9 987 184	11 908 605	4.83%	6 204 324	3 396 348
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**242 418 994**	10%	**59 511 457**	**182 907 537**	7.51%	**55 868 835**	**30 412 942**

Make Scenario Modelling

With COGS sold reduction

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Business Level 1	2 611 049 880	423 171 358	2 187 878 522	1 376 150 881	220 962 743	10%	49 524 273	171 438 470	7.84%	49 664 510	27 016 594
Business Level 2	351 953 029	105 644 221	246 308 808	161 249 012	22 959 011	9%	9 987 184	12 971 826	5.27%	6 204 324	3 396 348
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 537 399 893**	**243 921 754**	**10%**	**59 511 457**	**184 410 297**	**7.58%**	**55 868 835**	**30 412 942**

Difference in GP1	Difference in GP6	**0.06%**
	Total saving	**1 502 760**

Make Case Study per Business Level – GP6 impact of 0.06 percent

As-Is Cost

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%
Sales Region 1	840 166 935	130 167 264	709 999 671	371 918 791	338 080 880	47.6%
Sales Region 2	324 431 799	51 738 407	272 693 391	149 159 108	123 534 284	45.3%
Sales Region 3	232 681 704	31 934 442	200 747 263	105 488 859	95 258 404	47.5%
Sales Region 4	63 565 669	10 987 537	52 578 132	30 194 478	22 383 654	42.6%
Sales Region 5	228 825 296	81 605 377	147 219 918	93 133 627	54 086 291	36.7%
Sales Region 6	53 574 478	5 377 984	48 196 494	35 323 259	12 873 235	26.7%
Sales Region 7	454 226 947	79 121 754	375 105 193	267 540 460	107 564 732	28.7%
Sales Region 8	613 799 520	102 855 328	510 944 192	382 076 190	128 868 002	25.2%
Sales Region 9	151 730 561	35 027 485	116 703 076	104 067 881	12 635 195	10.8%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**36.8%**

Make Scenario Modelling

With COGS sold reduction

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%
Sales Region 1	840 166 935	130 167 264	709 999 671	371 399 897	338 599 774	47.7%
Sales Region 2	324 431 799	51 738 407	272 693 391	148 864 929	123 828 463	45.4%
Sales Region 3	232 681 704	31 934 442	200 747 263	105 362 695	95 384 567	47.5%
Sales Region 4	63 565 669	10 987 537	52 578 132	30 193 568	22 384 563	42.6%
Sales Region 5	228 825 296	81 605 377	147 219 918	93 009 132	54 210 786	36.8%
Sales Region 6	53 574 478	5 377 984	48 196 494	35 323 259	12 873 235	26.7%
Sales Region 7	454 226 947	79 121 754	375 105 193	267 333 731	107 771 461	28.7%
Sales Region 8	613 799 520	102 855 328	510 944 192	381 762 339	129 181 853	25.3%
Sales Region 9	151 730 561	35 027 485	116 703 076	104 150 342	12 552 734	10.8%
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 537 399 893**	**896 787 437**	**36.8%**

Difference in GP1	**0.06%**

Make Case Study per Sales Region Level– GP1 impact of 0.06 percent

As-Is Cost

Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Sales Region 1	840 166 935	130 167 264	709 999 671	371 918 791	338 080 880	47.6%	22 419 862	164 759 649	23%	16 211 934	148 547 715	21%	14 661 980	7 156 374
Sales Region 2	324 431 799	51 738 407	272 693 391	149 159 108	123 534 284	45.3%	12 154 812	44 899 702	16%	6 168 899	38 730 803	14%	6 084 079	3 044 284
Sales Region 3	232 681 704	31 934 442	200 747 263	105 488 859	95 258 404	47.5%	10 286 153	35 419 936	18%	4 402 513	31 017 423	15%	4 133 298	2 102 235
Sales Region 4	63 565 669	10 987 537	52 578 132	30 194 478	22 383 654	42.6%	1 325 302	13 939 507	27%	1 181 950	12 757 558	24%	1 018 255	524 396
Sales Region 5	228 825 296	81 605 377	147 219 918	93 133 627	54 086 291	36.7%	2 900 481	15 413 102	10%	6 785 049	8 628 053	6%	3 539 258	1 843 548
Sales Region 6	53 574 478	5 377 984	48 196 494	35 323 259	12 873 235	26.7%	666 026	3 823 354	8%	592 283	3 231 070	7%	1 952 550	1 950 361
Sales Region 7	454 226 947	79 121 754	375 105 193	267 540 460	107 564 732	28.7%	24 266 160	(6 843 632)	-2%	7 393 926	(14 237 558)	-4%	8 988 904	5 030 913
Sales Region 8	613 799 520	102 855 328	510 944 192	382 076 190	128 868 002	25.2%	22 967 120	(2 165 847)	0%	13 225 849	(15 391 696)	-3%	12 006 734	6 821 897
Sales Region 9	151 730 561	35 027 485	116 703 076	104 067 881	12 635 195	10.8%	8 861 686	(26 826 778)	-23%	3 549 054	(30 375 832)	-26%	3 483 777	1 938 934
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 538 902 653**	**895 284 677**	**36.8%**	**105 847 602**	**242 418 994**	**10%**	**59 511 457**	**182 907 537**	**8%**	**55 868 835**	**30 412 942**

Make Scenario Modelling

With COGS sold reduction

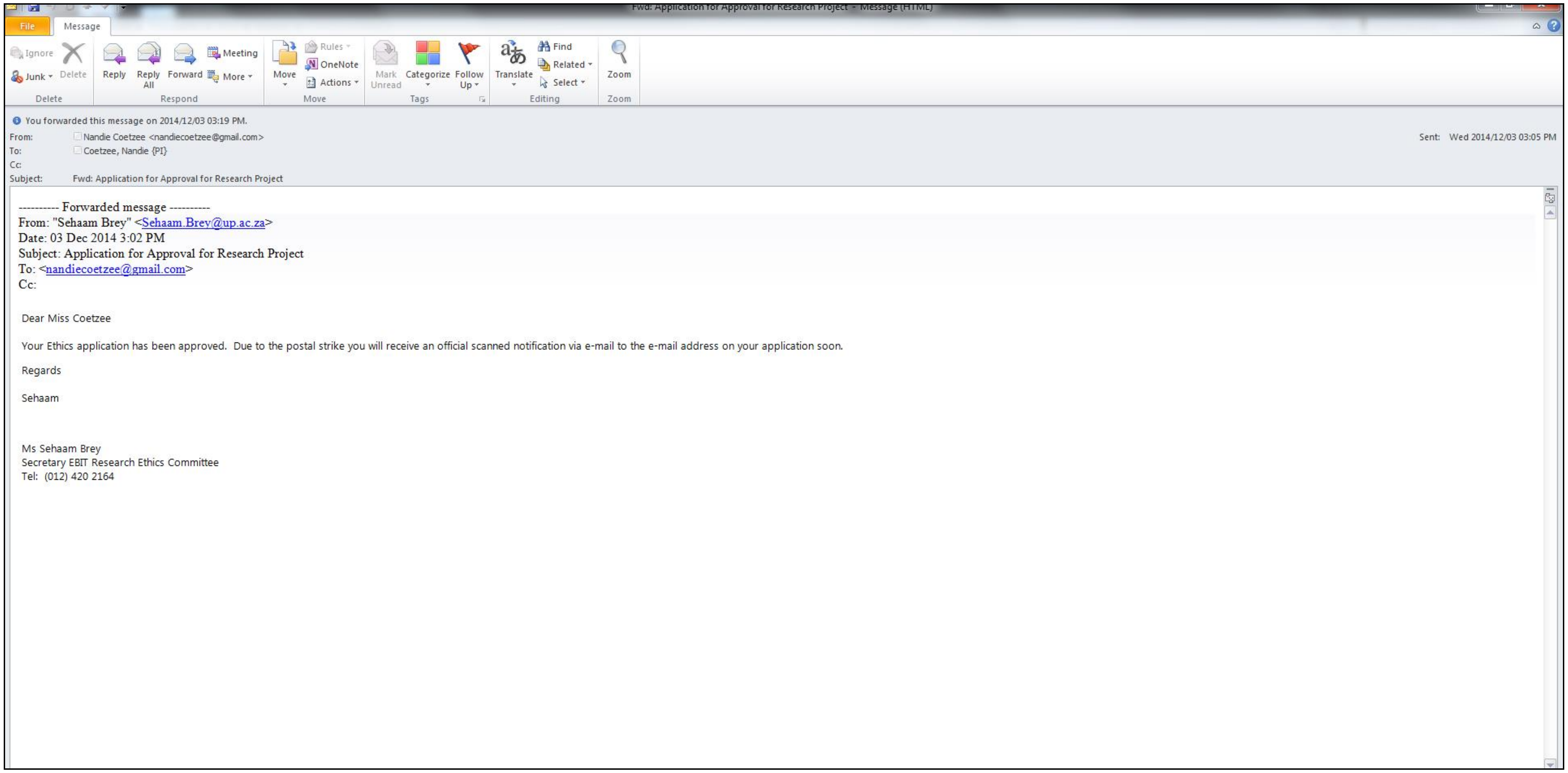
Business Level	Gross Revenue	Discount & Allowances	Net Revenue	Cost of Goods Sold (COGS)	GP1	GP1%	Storage	GP5	GP5%	Advertising & Marketing	GP6	GP6%	Invoice Sales Volume (kg's)	Invoice Sales Volume Cases
Sales Region 1	840 166 935	130 167 264	709 999 671	371 399 897	338 599 774	47.7%	22 419 862	165 278 543	23%	16 211 934	149 066 609	21%	14 661 980	7 156 374
Sales Region 2	324 431 799	51 738 407	272 693 391	148 864 929	123 828 463	45.4%	12 154 812	45 193 881	17%	6 168 899	39 024 982	14%	6 084 079	3 044 284
Sales Region 3	232 681 704	31 934 442	200 747 263	105 362 695	95 384 567	47.5%	10 286 153	35 546 099	18%	4 402 513	31 143 587	16%	4 133 298	2 102 235
Sales Region 4	63 565 669	10 987 537	52 578 132	30 193 568	22 384 563	42.6%	1 325 302	13 940 416	27%	1 181 950	12 758 467	24%	1 018 255	524 396
Sales Region 5	228 825 296	81 605 377	147 219 918	93 009 132	54 210 786	36.8%	2 900 481	15 537 597	11%	6 785 049	8 752 549	6%	3 539 258	1 843 548
Sales Region 6	53 574 478	5 377 984	48 196 494	35 323 259	12 873 235	26.7%	666 026	3 823 354	8%	592 283	3 231 070	7%	1 952 550	1 950 361
Sales Region 7	454 226 947	79 121 754	375 105 193	267 333 731	107 771 461	28.7%	24 266 160	(6 636 903)	-2%	7 393 926	(14 030 829)	-4%	8 988 904	5 030 913
Sales Region 8	613 799 520	102 855 328	510 944 192	381 762 339	129 181 853	25.3%	22 967 120	(1 851 996)	0%	13 225 849	(15 077 845)	-3%	12 006 734	6 821 897
Sales Region 9	151 730 561	35 027 485	116 703 076	104 150 342	12 552 734	10.8%	8 861 686	(26 909 238)	-23%	3 549 054	(30 458 293)	-26%	3 483 777	1 938 934
	2 963 002 909	**528 815 580**	**2 434 187 330**	**1 537 399 893**	**896 787 437**	**36.8%**	**105 847 602**	**243 921 754**	**10%**	**59 511 457**	**184 410 297**	**8%**	**55 868 835**	**30 412 942**

Difference in GP1	**0.06%**

Difference in GP6	**0.06%**
Total saving	**1 502 760**

Make Case Study per Sales Region Level– GP6 impact of 0.06 percent

14. Appendix H



Fwd: Application for Approval for Research Project - Message (HTML)

You forwarded this message on 2014/12/03 03:19 PM.

From: Nandie Coetzee <nandiecoetzee@gmail.com>

To: Coetzee, Nandie (PI)

Cc:

Subject: Fwd: Application for Approval for Research Project

Sent: Wed 2014/12/03 03:05 PM

---------- Forwarded message ----------
From: "Sehaam Brey" <Sehaam.Brey@up.ac.za>
Date: 03 Dec 2014 3:02 PM
Subject: Application for Approval for Research Project
To: <nandiecoetzee@gmail.com>
Cc:

Dear Miss Coetzee

Your Ethics application has been approved. Due to the postal strike you will receive an official scanned notification via e-mail to the e-mail address on your application soon.

Regards

Sehaam

Ms Sehaam Brey
Secretary EBIT Research Ethics Committee
Tel: (012) 420 2164

15. Appendix I

20 July 2016

To whom it may concern

We hereby confirm that Nandie Coetzee (student no. 24096424) a student at the University of Pretoria conducted her research study, titled: **Quantifying the impact of green supply chain management: A South African Case Study** at our company.

Note that a confidentiality agreement has been entered into with the case study company; therefore any financial information, monetary amounts and customer information may not be published.

Although substitute financial values, values similar to the actual financial values have been used in reporting the case study results in the document, the relationship between the values remains unchanged to reflect true results implementing the green business profitability framework. The actual values will be used to establish reliability and validity of the study and to audit the results but cannot be published in this report.

We give permission that the report can be submitted for examination but cannot be published.

Kind regards

Ted WillCox

CFO - SSA BU

Herman Muller

Customer Service & Logistics Director