DETERMINING SUPPLY CHAIN PRACTICES AND STRATEGIES OF LIGHT VEHICLE MANUFACTURERS IN SOUTH AFRICA

by

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Submitted in accordance with the requirements
for the degree of

DOCTOR OF COMMERCE

in the subject of

BUSINESS MANAGEMENT

at the

UNIVERSITY OF SOUTH AFRICA

PROMOTER: PROF JA BADENHORST-WEISS

NOVEMBER 2012

Student number: 4494-366-0

I declare that *“**DETERMINING SUPPLY CHAIN PRACTICES AND STRATEGIES OF LIGHT VEHICLE MANUFACTURERS IN SOUTH AFRICA**”* is my own work and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

30 November 2012

IM Ambe **DATE**

ACKNOWLEDGEMENTS

I am humbled and grateful to the Lord Almighty for seeing me through this project. He guided, strengthened, blessed and surrounded me with people to help, support and encourage me throughout this journey. I would like to acknowledge the following people and institutions:

- My wife, Akemeseh Florence Ambe, and my two beautiful daughters, Didi QueenMcFlore Ambe and Azah Hannie Ambe, thank you for your unconditional love and sacrificing so many hours of their time supporting me.
- My promoter, Prof Badenhorst-Weiss, for your endless guidance, dedication, wisdom and above all your patience to always accommodate me. You are much more than a promoter.
- Dr Marthi Pohl, thank you for your wonderful insight and contributions to designing the interview questionnaire and the statistics; Mrs Moya Joubert for her skilled language editing; and Dr Norman Lamprecht for his sound advice.
- To my family (my mother, brothers and sisters). I really appreciate your support and encouragement, especially Prof CM Ambe.
- To all my colleagues and friends, Prof Johan Strydom; Prof Tersia Brevis-Landsberg; Winnie Dlamini, Heidi Trollip, Letitia Marcantuono and Alicia Snyman - I am eternally grateful for your support and encouragement. I also wish to extend a special word of thanks to Dr DJ Nel - you were my strength; and to Ms Roseline Basey - thank you for all your advice and support.
- To all the manufacturers (participants) who assisted me with this study. I am extremely grateful for the sacrifices you made and your support, giving up your valuable time to participate in the study.
- To all the members of Sustainable Community Development and Training (SCDT): I appreciate the support, love and togetherness we share as a family.
- The Centre for Business Management: I truly appreciate the financial support without which completion would have been difficult.
- And to all those whom I have not mentioned, and who contributed in some way or the other - thank you so much.

ABSTRACT

This study determined whether local manufacturers of light vehicles in South Africa employ supply chain best practices and strategies. The research design employed was a combination of exploratory and descriptive research design using qualitative and quantitative approaches based on a survey of light vehicle manufacturers in South Africa. A face-to–face, semi-structured interview questionnaire was used, based on purposive sampling. Descriptive statistics using SPSS software were used for the data analysis and interpretation. The findings of the study revealed that across the supply chain, best practices were implemented to a large extent by all manufacturers. Light vehicle manufacturers in South Africa, however face supply chain challenges, which include technological, infrastructural, cost, market/service and production/skills challenges. The most important supply chain performance indicator that contributes to optimisation of performance is quality, followed by final product delivery reliability, and then cost and supplier reliability.

All the manufacturers followed a lean strategy for their inbound supply chain and some had a lean supply chain strategy for their outbound supply chain. A number of them also had an agile supply chain strategy in the outbound supply chain which suggests a leagile supply chain strategy. It was also found that in some instances there was a mismatch between strategies and practices in the area of product characteristics, manufacturing characteristics and the decision drivers of supply chain. One of the conclusions of the study was that local manufacturers of light vehicles do not always make decisions and implement practices in line with their chosen supply chain strategies. The study concluded by developing a framework for determining supply chain best practices in line with a chosen strategy that could guide supply chain managers (in locally manufactured light vehicles) in the automotive industry in South Africa in their decision making.

Key terms: supply chain management, supply chain challenges, supply chain practices, supply chain strategies, lean supply chain strategy, agile supply chain strategy, leagile supply chain strategy, vehicles manufacturers, automotive industry, and key performance indicators.

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ABM:	activity-based management
ACMs:	automotive component manufacturers
APDP:	Automotive Production Development Programme
AIDC:	Automotive Industry Development Centre
ATO:	assemble-to-order
BPR:	business process re-engineering
BTT:	Board on Tariffs and Trade
BBEEE:	Broad-Based Black Economic Empowerment
CAD:	computer-aided design
CAE:	computer-aided engineering
CAM:	computer-assisted manufacturing
CAPP:	computer-aided process planning
CBUs:	completely built-up vehicles
CE:	concurrent engineering
CCIG:	Catalytic Converter Interest Group
CTO:	configure- to-order
CKD:	completely knocked down
CRM:	customer relationship management
DTI:	Department of Trade and Industry
DCs:	distribution centres
DP:	decoupling point
ETO:	engineer-to-order
EIDD:	Enterprise and Industry Development Division
FPS:	Ford production system
FDI:	foreign direct investment
GDP:	gross domestic product
GATT:	General Agreement on Tariff and Trade
GSCF:	Global Supply Chain Forum
IT:	information technology
ITAC:	International Trade Administration Commission
IMVP:	International Motor Vehicle Programme
ILO:	International Labour Office
JIT:	just-in-time

MIDP:	Motor Industry Development Programme
MIDC:	Motor Industry Development Council
MTO:	make-to-order
MTS:	make-to-stock
NAAMSA:	National Association of Automobile Manufacturers of South Africa
NAACAM:	National Association of Automotive Component and Allied Manufacturers
NUMSA:	National Union of Metalworkers of South Africa
OEMs:	Original equipment manufacturers
OESs:	Original equipment suppliers
OICA :	Organisation Internationale des Constructuers d'Automobiles
PDM:	product data management
PLC:	product life cycle
RMI:	Retail Motor Industry Organisation
R&D:	research and development
SCD:	supply chain design
SCOR:	supply chain operations reference
SCI:	supply chain integration
SCM:	supply chain management
SARS:	South African Revenue Services
SABS:	South African Bureau of Standards
SPSS:	Statistical Package for Social Sciences
SRM:	supplier relationship management
SATMC:	South African Tyre Manufacturers Conference
TBM:	time-based management
TPS:	Toyota Production System
TQC:	total quality control
TQM:	total quality management
VMI:	vendor-managed inventory
WTO:	World Trade Organization

CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 BACKGROUND TO THE STUDY

The turbulent market conditions today have heightened the need for alternative strategies for growth to be developed (Sanchez & Perez 2005:681). Business, economics and political environments are increasingly subjected to unexpected shocks and discontinuities (BERA 2004; GoldSim 2007). Many strategic issues that confront business today stem from the new rules of competition, globalisation, downward pressure on prices and the customer taking control (Korsunsky 2010:5). Events are moving so rapidly that it is almost impossible to grasp the implications of changes in the business environment for the days ahead, let alone the years to come (Njoroge 2009:2).

The automotive industry is highly competitive and characterised by growing world competition with increasingly demanding customers (Christopher & Towill 2001; Christopher & Rutherford 2005; Zhan & Chen 2006; Schwarz 2008). Increases in competition and complexity have led to supply chain becoming an important issue for companies (Hur, Hartley & Hahn 2004; Hugo, Badenhorst & Van Biljon 2004; Christopher 2005). The role of supply chain management (SCM) as a source of competitive advantage for the automobile industry has been acknowledged (Gunasekaran & Ngai 2004; Hugo et al 2004; Wei & Chen 2008). To achieve a competitive advantage, organisations have to be responsive to constantly changing market and business environments (Lee 2004; Christopher 2005; Ismail & Sharifi 2006; Iskanius, 2006).

In South Africa, the automotive industry plays a significant role in the economy, and is often referred to as the barometer of the health of the economic state of the country. Yet many companies in the sector have little or no indication of the costs involved in maintaining their supply chains, nor of the impact that these have on their operations (Datascope Consulting 2008:84). The industry faces huge supply chain challenges stemming from inventory-holding costs, lead time and visibility, all of which have serious consequences for the performance of the industry (Supplychainforesight 2007). This study therefore explores supply chain best practices and strategies of light vehicle manufacturers in South Africa, in order to make a contribution to better understanding the industry, and investigating and finding appropriate supply chain strategies.

1.2 SUPPLY CHAIN MANAGEMENT (SCM)

1.2.1 Introduction

Supply chain management (SCM) is critical for the success of organisations as they need to respond to increasing levels of volatility in demand (Christopher & Towill 2001; Wilding & Humphries 2006:310; Khan & Burnes 2007:197; Fawcett, Magnan & McCarter 2008:35). SCM has gained recognition as a powerful tool that affords companies the opportunity to achieve a competitive advantage (Christopher 2005:6). Hugo et al (2004:5) assert that SCM looks for opportunities to generate revenues for the company and potentially increase its market share by providing customers with the products or services they need.

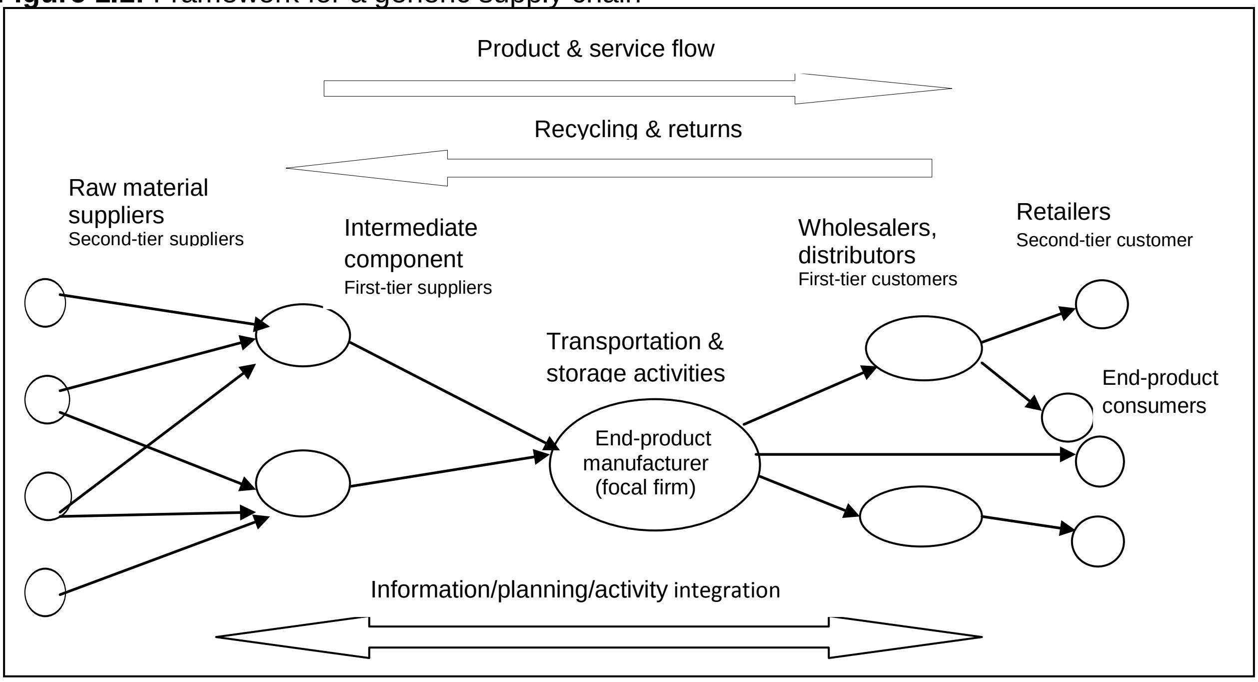
1.2.2 Definition of SCM

There are various definitions of SCM. According Leenders and Fearon (2004:10), "SCM is the systems approach to managing the entire flow of information, materials and services from the raw materials suppliers through factories and warehouses to the end customer". Christopher (2005:5) defines SCM as "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole". Gansler, Luby and Kornberg (2004:8) note that SCM is the management and control of all materials, funds and related information in the logistics process from the acquisition of raw materials to the delivery of finished products to the end user.

Hugo et al (2004:5) define SCM "as the management philosophy aimed at integrating a network of upstream linkages (sources of supply), internal linkages inside the organisation and downstream linkages (distribution and ultimate customer) in performing specific processes and activities that will ultimately create and optimise value for the customer in the form of products and services which are specifically aimed at satisfying customer demands". According to Wisner, Tan and Leong (2008:8), SCM is the "the design and management of seamless, value-added processes across organisational boundaries to meet the real needs of the end customer". The above definitions represent the various views of many literature sources. Although the definitions of SCM differ to some extent, they can be classified in the following three categories: a management philosophy; implementation of a management philosophy; and as a set of management processes (Klemencic 2006:13; Lambert 2006).

According to Handfield, Monczka, Giunipero and Patterson (2009:10), a supply chain (SC) is a set of three or more organisations linked directly by one or more of the upstream or downstream flow of products, services, finances and information from a source to a customer. As noted by Fawcet, Ellram and Ogden (2007:10), effective management of these flows requires creating synergistic relationships between the supply and distribution partners with the objective of maximising customer value and providing a profit for each supply chain member. A supply chain is viewed as the formation of a value chain network consisting of individual functional entities committed to the controlled sharing of business data and processes. Supply chain links suppliers and customers from the extraction of raw materials until the product reaches the ultimate end user and may include suppliers, manufacturers, distributors, retailers and customers (Wisner, Tan & Leong, 20012:6). Within each of these organisations (or stages), the functions include but are not limited to new product development, marketing, operations, distribution, finance, purchasing and customer service (Klemencic 2006:7; Lambert 2006). Figure 1.1 below shows a framework for a supply chain.

Figure 1.1: Framework for a generic supply chain



Source: Wisner et al (2008a:6)

Companies today increasingly recognise that improved management of their supply chain can be a source of competitive advantage (Sherer 2005:77). SCM has merged many management developments or concepts together, such as just-in-time (JIT), total quality control (TQC), total quality management (TQM), time-based management (TBM), lean thinking, activity-based management (ABM) and business process re-engineering (BPR).

These are all aimed at improving business processes (Sharifi, Ismail & Reid 2006:1080). Numerous studies have dwelt on the importance of SCM as a strategy for competitive advantage in organisations (Diaz 2005; Iskanius 2006; Thatte 2007; Petterson 2009; Roh 2009). This study examines supply chain best practices and strategies and suggests a conceptual supply chain framework to align practices with the chosen strategy.

1.3 SUPPLY CHAIN BEST PRACTICES IN THE AUTOMOTIVE INDUSTRY

1.3.1 Overview of the global automotive industry

The automotive industry is one of the most global of all industries, with its products spread around the world and dominated by small companies enjoying worldwide recognition (Barnes & Morris 2008:32; Humphrey & Memedovic 2003:2; Lamprecht 2009:130). The industry comprises the largest manufacturing sector in the world, with an output equivalent to that of the world's sixth largest economy (Nag, Banerjee & Chatterjee 2007:1; OICA 2008). While the industry is a key activity in advanced industrial nations, it is also of increasing significance in the emerging economies of North and East Asia, South America and Eastern Europe (Nag et al 2007:1).

The industry is also one of the largest investors in research and development (R&D), playing a key role in society-wide technological development (Commonwealth of Australia 2008; OICA 2009). The global automotive industry is currently led by the main manufacturers (OEMs), that is, Toyota, General Motors (GM), Volkswagen, Ford, Honda, PSA, Nissan, BMW and Chrysler, which function in an international competitive market (Naude 2009:33). According to Ciferri and Revill (2008:1), the global financial crisis in 2008 triggered a major decline in the number of OEMs, leading to consolidation in 2010 (Deutsche Bank Research 2009:2).

Global car production in 2008 was 52.64 million units, a modest 1.06% drop from the 53.20 million total of 2007. China was the largest and most dynamic market, with domestic production reaching 6.74 million cars. Although China was the world's largest vehicle market in 2008, Japan was the world's largest producer with 11.56 million vehicles, after a 0.3% year-on-year decline in output (ILO 2010:8). China produced 9.35 million vehicles, displacing the USA, which produced 8.71 million vehicles and this US figure represented a 19.3% year-on-year decline after the second half of 2008 when the market fell as a result of the economic crisis (ILO 2010:11). The global automotive industry employed between 7.6 million and 9.2 million people in 42 countries. According to the ILO (2010:9), it is estimated that this figure was 8.6 million at the end of December 2002, and 8.4 million at the end of 2008. This industry leads all other industries in research and development (R&D) investments and its levels of productivity are well above average (Afsharipour, Afshari & Sahaf 2006:1; OICA 2009).

The industry is capital intensive and technologically advanced both in terms of manufacturing processes and its products (Wei & Chen 2008:973; Lamprecht 2009:7). Within the industry, the level of competition increases and production bases of most of auto-giant companies are being shifted from the developed countries to developing countries to take advantage of the low cost of production (Nag et al 2007:4). Automotive products have spread around the world and the industry is dominated by a small number of companies with worldwide recognition (IBM 2009:1). Owing to the increasing competition and the number of vehicle models being introduced in segmented markets, executive managers are seeking both growth and cost reductions to make their companies more competitive and profitable. Vehicles are becoming more complex to be able to satisfy consumer demands for improvements in safety, fuel economy, performance and quality (IBM 2009:1). Automakers are constantly under pressure to identify consumer preferences, national biases, and new market segments where they can sell vehicles and gain market share. Their ability to be flexible enough to quickly respond to all these pressures is determining their future in the industry. The implications of these factors are vast and propagate along the supply chain of the automakers (Veloso & Kumar 2002:2; Jin, Wang & Palaniappan 2005:370).

1.3.2 The South African automotive industry

South Africa's automotive industry is a global, turbo-charged engine for the manufacture and export of vehicles and components. South Africa has developed a major automotive industry with local vehicle manufacturing plants for Volkswagen, BMW, Nissan, General Motors, Ford, Mercedes Benz and Toyota (Van der Merwe 2009). Since the early 1990s, the South African automotive industry has been through a rapid process of adjustment as trade protection has been reduced (Black 2001:3). The globalisation of the industry has received much attention and the focus has been on the rapid increase in automotive exports. The industry is distinguished from other industrial sectors by the role of government policies steering its development (Lamprecht 2009:7). The Motor Industry Development Programme (MIDP) introduced in 1995, has played a massive role in promoting competitiveness and export expansion. The MIDP provides an effective platform for communication and cooperation and for all the relevant stakeholders to interact on automotive issues. The stakeholders in the automotive industry include government, labour and business (DTI 2004; Lamprecht 2006:238).

According to Ellis (2008), the MIDP will be replaced by a new automotive industry programme. This new programme will be the Automotive Production Development Programme (APDP) and it is anticipated to be implemented in January 2013 at the latest, when the MIDP concludes. It is crucial that all South African-based automotive firms begin to take the implications of the APDP into account with their business strategies. In the South African automotive sector, exports have increased rapidly, but imports have expanded equally rapidly. Consumers have benefited from a rapidly expanding range of makes and models, many of which are imported. Less visible and more difficult to measure is what lies beneath the bonnets of the half million vehicles being assembled annually in South Africa (Meyn 2004:13). South Africa is among the best performing emerging automobile markets in the world in recent years (NAAMSA 2008). However, industry employment levels have remained under pressure because of the global recession (Van der Merwe, 2009; Supplychainforesight 2010). Net industry employment fell by 2 571 jobs as a result of downsizing and operational adjustments at most of the industry's assembly operations in 2009. The industry's domestic sales projections reflect difficult trading conditions, whilst the global economic slowdown impacted negatively on automotive industry exports in 2009 (NAAMSA 2009).

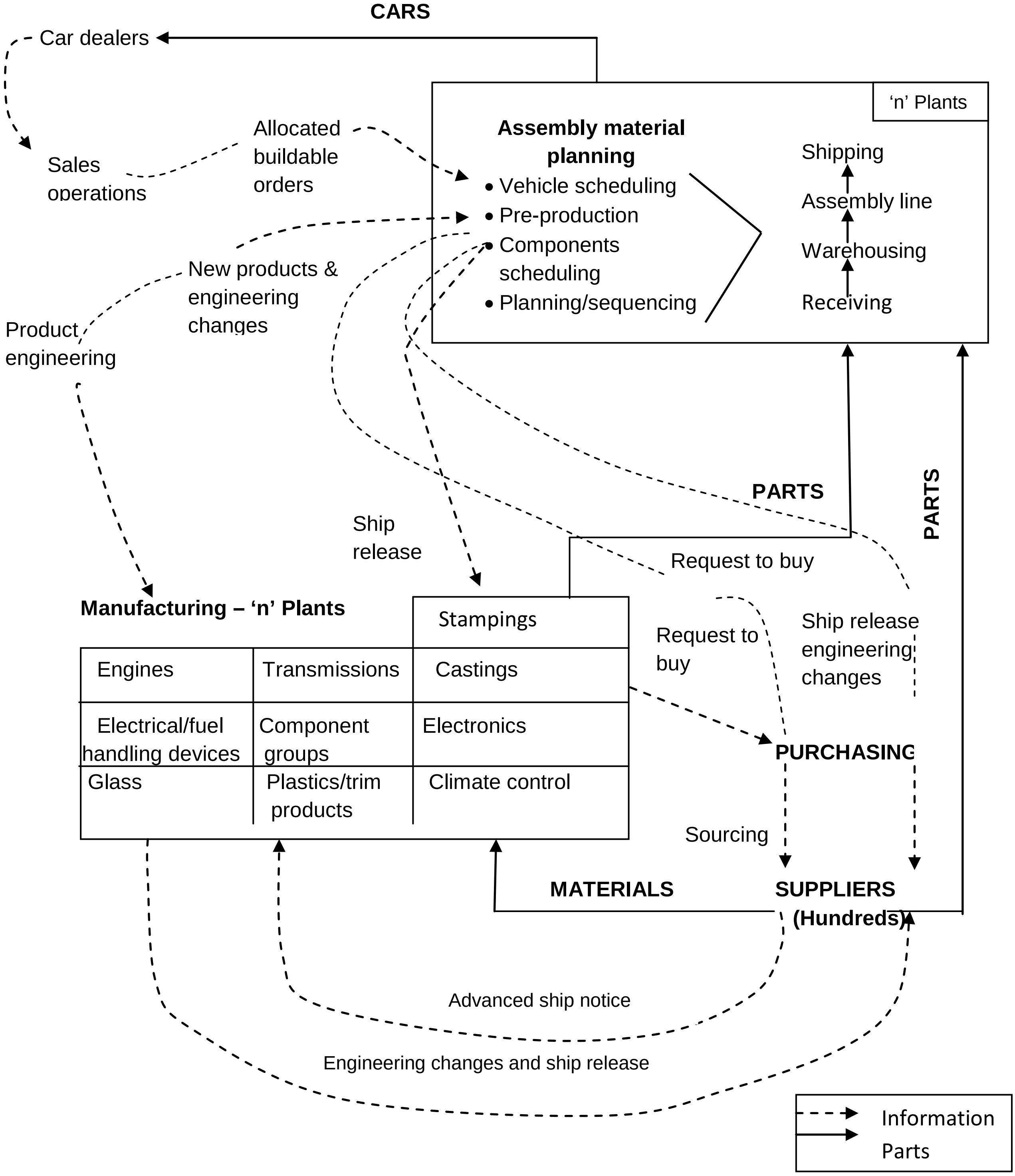
According to Kehbila, Ertel and Brent (2009:310), the automotive industry is the largest manufacturing sector in South Africa. Manufacturing vehicles requires the employment of about 9 million people directly in producing the vehicles and the automotive components that go into them (AIEC 2012:13). According to the AIEC (2012:13) report, it is estimated that each direct automotive job supports at least another five indirect jobs, resulting in more than 50 million jobs globally owed to the automotive industry. The industry sector's contribution to South Africa's gross domestic product (GDP) was R2 964 billion in 2011 and amounted to 6.8%. A compounded annual growth rate of 20.5% in rand value terms for completely built-up vehicles (CBUs) and automotive components exports has been achieved since 1995, up to 2011 (AIEC 2012:13). South Africa currently exports vehicles to over 70 countries, such as Japan (around 29% of the value of total exports), Australia (20%), the UK (12%) and the USA (11%). African export destinations include Algeria, Zimbabwe and Nigeria (SAinfo 2008).

1.3.3 Automobile supply chain framework

The automotive supply chain integrates the following four groups of players: original equipment manufacturers (OEMs), automotive component manufacturers (ACMs) (first-tier suppliers), subtier suppliers and infrastructure suppliers in the supply side of auto manufacturing (Lamprecht 2009:160). The supply chain stretches from the producers of raw materials through to the assembly of the most sophisticated electronic and computing technologies (Tang & Qian 2008:288; Wei & Chen 2008:974). The major component of the supply chain includes ACM suppliers (tier 2-3), OEMs, distribution centres, dealers and customers (Rubesch & Banomyong 2005:61). Most OEMs create 30 to 35% of value internally and delegate the rest to their suppliers (Afsharipour et al 2006:5). In South Africa, the automotive supply chain is segmented and comprises eight major OEMs that are supplied by approximately 275 first-tier suppliers, 100 second-tier suppliers and more than 200 third- and fourth-tier suppliers (Khayundi 2010:19). Critical challenges for consideration in the industry's supply chain are cost containment, development know-how and resources, product quality and logistics (Khayundi 2010:20).

As proposed by Turner and Williams (2005:449), the traditional downstream supply chain, from the OEM perspective, begins with production scheduling. The objective is to keep production as stable as possible. The stages in the production of motor vehicles as denoted by Muller (2009:2) stem from stamping, body shop, painting and final assembly. The majority of assembly operations take place in the body shop and final assembly (Kuhn 2006:1101). Tang and Qian (2008:288) contend that to improve the ability to innovate, deliver cars to the market faster and reduce errors, automotive manufacturers need to improve their development and management abilities through advances in computer-aided design (CAD), computer-aided process planning (CAPP), computer-assisted manufacturing (CAM), computer-aided engineering (CAE), concurrent engineering (CE), product data management (PDM) and business process engineering. Figure 1.2 below depicts a framework for the automotive supply chain.

Figure 1.2: Framework for the automotive supply chain



Source: Handfield et al (2009:14); Manjunatha, Shivanand & Manjunath (2009:660)

1.3.4 Supply chain challenges in the South African automotive industry

The automotive industry is an important contributor to the South African economy. The industry was South Africa's most heavily protected industry before trade liberalisation was launched in the 1990s (Flatters & Netshitomboni 2006:3). The industry, which has attracted much government attention and a wide range of public support (Ambe & Badenhorst-Weiss, 2011:337), has managed to achieve operations among all role players and is now fully integrated into the global framework of parent companies and multinationals (Fernandes & Erasmus 2005:3). All of the major vehicle manufacturers are represented in South Africa. Many of them use South Africa to source components and assemble vehicles for both the local and the overseas markets (Muller 2009:1; Van der Merwe 2009:1).

A growth catalyst of the South African automotive industry has been the government's Motor Industry Development Programme (MIDP) (as mentioned previously). Compliance with the World Trade Organisation (WTO) led the South African government to review the MIDP and replace it with the Automotive Production Development Programme (APDP) (also mentioned previously) (Ambe & Badenhorst-Weiss 2011:337). This involved a shift from export support to production support, while phased-down tariff reductions (albeit at a slower pace) are transitionally maintained as the MIDP gives way to the APDP (Mohubetswane 2010:53).

Supplychainforesight (2010) and Ambe and Badenhorst-Weiss (2011:353) have pointed out that the South African automotive industry faces great supply chain challenges. These include the establishment of cost reduction measures and service improvement (Supplychainforesight, 2007). Moreover, the majority of companies in the industry not only operate with low levels of collaboration, but are also not market sensitive or reactive to the changing market (Supply Chain Intelligence Report [CSIR] 2009). The Supply Chain Foresight report (2010) also highlights the fact that the industry supply chain is more vulnerable than ever as a result of vast swings in demand and volumes because of the global recession.

In addition, ACMs (automotive component manufacturers), feel pressure from OEMs to reduce prices, and are constrained by excessive inventory, the unreliability of rail transport and rail capacity problems, the high cost of South African ports, the cost of replacing outdated technology and broad-based black economic empowerment, and a lack of skills and labour problems, both of which are time-consuming to resolve (Naude & Badenhorst-Weiss 2011:96). Many of these challenges are also encountered by the other role players in the automotive industry. There is thus a need for South African automotive industry manufacturers to produce at a competitive cost and to have the ability to respond quickly and reliably to First World market demands (Ambe & Badenhorst-Weiss 2011:355).

Also, the challenges affecting the automotive industry in South Africa have led manufacturers and suppliers to build up buffer inventory and limit their ability to react flexibly to changes in customer demand (Supplychainforesight, 2010). Datascope Consulting (2008:85) pointed out that manufacturers forced their second-tier manufacturers to hold larger inventory levels to avoid bringing a large manufacturing line to a halt. These challenges can be attributed to mismatches in the supply chain (Fisher 1997; Lee 2002:105; Hines 2006:57). Fisher (1997) attributes the root cause of the problems plaguing many supply chains to a mismatch between types of environmental uncertainty and supply chain strategy (Lee 2002:105; Hines 2006:57). Therefore choosing and implementing the right strategy for the supply chain to satisfy customer demands is vital for automotive manufacturers, their suppliers and the economy as a whole. According to Sun, Hsu and Hwang. (2009:201) it is believed that the right supply chain strategy can improve SCM performance (Christopher. Lowson & Peck 2004:367).

1.4 SUPPLY CHAIN STRATEGIES

Owing to an awareness of the need to align processes with trading partners to achieve business outcomes, business competition has shifted from a traditional firm basis to a supply chain-wide basis (Hugo et al 2004:22; Lo & Power 2010:140). A supply chain strategy is part of the overall business strategy, designed around a well-defined basis of competition (innovation, low cost, service and quality) (Cohen & Rousell 2005:10). Supply chain strategy utilises interfirm coordination as the capability that facilitates achievement of objectives focused on revenue growth, operating cost reduction, working capital and fixed capital efficiency to maximise shareholder value (Defee & Stank 2005:33).

Supply chain scholars have agreed that a supply chain strategy should be chosen on the basis of the type of product and by matching the strategy to the unique characteristics of different products or markets (Fisher 1997; Lee 2002; Sebastiao & Golicic, 2008). The Fisher (1997) model has helped managers to understand the nature of their product and to devise a supply chain strategy that can best satisfy the specific demand (Jacobs, Chase & Aquilano, 2009:362). According to Fisher’s model, supply chain strategy is established on the basis of the product type (functional or innovative products) (Fisher 1997:107; Jacobs et al

2009:362). Lee (2002:106) introduced a framework for establishing a strategy based on supply and demand uncertainties. Lee (2002:107) elaborates on the match between strategy and product characteristics by considering stable versus evolving supply characteristics in addition to demand. According to Lee (2002:107), efficient and responsive supply chain strategies are associated with stable supply processes while risk-hedging and an agile supply chain are associated with conditions of evolving supply processes (Sebastiao & Golicic 2008:76).

Chopra and Meindl (2010:44) consider two main strategies for the supply chain (efficiency and responsiveness) and introduce a three-step procedure for achieving strategic fit. Furthermore, Christopher and Towill (2002:8) contend that there are different pipelines to satisfy customer demands, but these pipelines must be selected to match the business strategy of the supply chain. Christopher and Towill (2002:9) also note that the element to influence the choice of supply chain strategy is the specific "market winner" criterion. Where cost is the primary market winner, the emphasis must be on efficiency, which will imply lean strategies (Hines 2006:131).

Fawcett et al (2007:222) also note that a supply chain strategy can be determined from the product life cycle (PLC). The PLC summarises all the steps from the product design and development phases to the decision to remove the product from the market. The product goes through an introduction, growth, maturity and a declining phase (Aitken, Childerhouse & Towill 2003:135; Astrom & Ohgren 2010:21). Different types of products, that is, innovative, hybrid or functional, can be classified into different phases of the PLC. Simchi-Levi, Kaminsky and Simchi-Levi (2003) distinguish between push and pull supply chains (Diaz 2005:65). A push-oriented supply chain caters to stable demand for homogenised products. In this type of supply chain, production and distribution decisions are based on long-term forecasts, because demand is stable. In the pull supply chain, the entire supply chain is driven by actual demand.

There are several factors (some of which were touched on above) that should be taken into account to determine supply chain strategies. Some of the factors include the demand and supply characteristics of a product; the market winners and market qualifiers; the product life cycle; pull and push strategies; manufacturing strategies; focus of the supply chain; type of customer; supply market; demand pattern; competency and capabilities; manufacturing techniques; and production techniques. However, despite the many views on strategies and attributes influencing them, Mason-Jones, Naylor and Towill (2000), Christopher and Towill

(2002), Christopher (2005), Hull (2005), Simons and Zokaei (2005), Hallgren and Olhager (2009), Vinodh, Sundararaj and Devadasan (2009) and Pandey and Garg (2009) acknowledge two main strategies in the supply chain depending on supply and demand. These strategies are termed "generic" supply chain strategies and include "leanness" and "agility". Identifying the types of supply chain strategies (lean or agile) may be appropriate in different circumstances to position the product in an organisation's portfolio according to its supply and demand characteristics. In this study, supply chain practices and strategies were explored and with empirical study characteristics of different automotive supply chains were investigated to determine the appropriateness of the strategies (lean or agile) employed in the South African automotive industry to achieve a competitive advantage.

1.4.1 Lean supply chain

"Lean" is a supply chain term defined as the "enhancement of value by the elimination of waste" (Womack & Jones 2003) Taj (2005:219) noted that in a holistic perspective, the idea of "lean supply" is adopted from the concept of "lean production" (Womack, Jones & Roos 1990). According to Hilletofth (2009:19), the term originated from a major automotive-industry study, the International Motor Vehicle Program (IMVP), based in MIT during the period 1986 to 1990. Because of where it originated and the influence of *Kiichiro Toyota*, it is commonly known as the Toyota Production System (TPS). According to Hallgren and Olhager (2009:978), lean thinking is typically applied to manufacturing lean techniques and it focuses on areas where there are processes to improve, including the entire supply chain. A lean supply chain is one that produces exactly what and how much is needed, when it is needed, and where it is needed. The underlying theme in lean thinking is to produce more or do more with fewer resources while giving the end customer exactly what he or she wants. This means focusing on each product and its value stream. To do this, organisations must be ready to ask and understand which activities truly create value and which ones are wasteful. Lean is not simply about eliminating waste, it is about eliminating waste and enhancing value (Taj & Berro 2006:334; Hallgren & Olhager 2009:978).

According to Goldsby, Griffis and Roath (2006), the aim of leanness is to eliminate the various forms of waste which include defective products, overproduction, inventory, process waste, movement of people, transport of products and waiting by employees. Lean supply chains are usually combined with lean manufacturing and adopt a "zero inventory" approach (Christopher 2000). A lean supply chain is mainly concerned with cost reduction by operating the basic processes at minimum waste. Lean philosophy is applicable when market demand is predictable and buyers' decisions are highly dependent on the lowest price criterion. Owing to the fact that market demand is predictable, product supply is based on forecasts (Gattorna 2006:138). Customers in lean supply chains are delivered value through "low production cost and logistics achieved by using all available synergies and economies of scale" (Gattorna 2006:138).

1.4.2 Agile supply chain

Parallel developments in the areas of agility and SCM have led to the introduction of the concept of an agile supply chain (Iskanius 2006:101; Ismail & Sharifi 2006:432). While agility is accepted widely as a winning strategy for growth, the idea of creating agile supply chains has become a logical step for companies (Ismail & Sharifi 2006:432). According to them (2006:432), agility in a supply chain, is the ability of the supply chain as a whole and its members to quickly align the network and its operations to the dynamic and turbulent requirements of customers. The main focus is on running businesses in network structures with an adequate level of agility to respond to changes (responsiveness) as well as proactively anticipating changes and seeking new emerging opportunities (Sharifi et al 2006:1080). With the increase in competition, the current economic meltdown as well as companies wooing the customer, an agile supply chain has emerged as the new mantra. Those who can meet customer demands are more successful.

There are markets which are dominated by volatility of demand and short life cycle products resulting from fashion trends and technological developments. As a result, demand cannot be easily forecast. These market conditions call for placing emphasis on responsiveness instead of cost, as availability is a prerequisite for maintaining sales. In order to respond to changing market conditions, supply chains are required to become what is termed agile. Collin and Lorenzin (2006) stress the fact that agile supply chains aim to provide flexibility and speed in order to cope with external disruptions and sudden demand fluctuations. To achieve this, the pre-mentioned agile supply chain needs to provide a high degree of "visibility" to all members of the chain, enabling them to have a holistic, real time picture of the entire pipeline (Storey, Emberson & Reade 2005). Iskanius (2006:101) expresses the opinion that agile supply chains not only provide a timely response to the needs of the market, but also endeavour to provide end customers with products or services that meet their exact needs. It is for this reason that agile supply chains do not adopt a "wait and see" approach instead of a "what might be demanded approach". They do not replenish on a "make-to-stock" basis, depending on short-term forecasts as in the case of lean supply chains. They take action only when real demand occurs producing on a “make-to-order” basis, products which are already sold to or demanded by customers (Goldsby et al 2006). The members of the agile supply chain work together with the aim of satisfying the end customer, overcoming the barriers of individual performance improvement. They establish an integrated chain of businesses which operates as if the individual firms are one entity, enabling the flow of information, cash, resources and material (Ismail & Sharifi 2006:433).

1.4.3 Leagile supply chain

Numerous researchers have shown that lean and agility approaches can be integrated in a variety of ways (Faisal, Banwet & Shankar 2006:884; Krishnamurthy & Yauch 2007:591; Hilletofth 2009:20). This is because they complement one another, and can be linked to evolve a new manufacturing paradigm under the name leagile (Vinodh et al 2009: 573). Krishnamurthy and Yauch (2007: 591) define leagility as “a system in which the advantages of leaness and agility are combined”. The aim of leagile supply chains is to infuse competitiveness into an organisation in a cost-effective manner. Leagility is the combination of lean and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream, yet providing level schedule upstream from the decoupling point (Hull 2005:230; Vinodh et al 2009: 573; Rahiminia & Moghadasian 2010:81).

1.4.4 Conclusion

The essential elements of lean are generally well understood. Lean systems aim to reduce waste (where waste is anything that adds to cost, but not to the value of a product), they enable materials flow continuously through the system on a just in-time basis and there is an emphasis on error prevention, rather than on detection and post-hoc rectification. Lean principles emphasise system-level optimisation. The emphasis is on how the parts work together, rather than on the individual performance and excellence of any one feature or system component. To achieve a high degree of flexibility and customer responsiveness in the automotive industry, Elkins, Huang and Aiden (2004) note that it takes a combination of lean philosophy and new technology (agility) to quickly design new streamlined operations on the shop floor and beyond. Therefore, automotive companies must consider strategic initiatives such as agile supply chain systems to compete globally and at the same time respond to dynamic customer demands. This could be done through a combination of lean and agile supply chain strategies (the so-called ‘leagile’ supply chain). The supply chain may switch from one strategy to the other in the supply chain at the so-called 'decoupling-point' (Mason-Jones *et al.*, 2000:4065). The decoupling point is the point where order-driven and forecast-driven activities meet. Therefore a lean supply chain is a requirement for building an agile supply chain and in turn an agile supply chain is a strategy for responding to turbulent business environments. As denoted in the PRTM survey (2008 – 2010) "those who know how to set up, manage and rapidly configure their supply chains worldwide will outpace competitors in seizing market share".

1.5 BACKGROUND TO THE PROBLEM

Supply chain managers are confronted by significant challenges in managing their supply chains (Lo & Power 2010:139). This makes it necessary to take strategic decisions and to develop competitive supply chain strategies with capabilities that add value in the eyes of the customer (Lee 2002:105; Ismail & Sharifi, 2006:436). Fisher (1997) developed a model that helps managers determine their supply chain, based on the nature of the product (functional and innovative products). Scholars have contributed extensively to Fisher's model and have suggested that in addition to the "product", there are other factors that might influence the choice of a supply chain strategy (Lo & Power 2010:141). These are the result of several developments in the market, such as increased competition, increased demand variability, increased product variety, increased amounts of customer-specific products and product life cycles becoming shorter (Christopher et al 2004:367).

According to Sun et al (2009:201), choosing and implementing the right supply chain strategy is believed to help improve supply chain management (SCM) performance. The ability to design an effective supply chain strategy is an important core capability of SCM (Nel & Badenhorst-Weiss 2010:198). In South Africa, the automotive industry is the leading industry in supply chain practices (Supplychainforesight 2007). The industry is often referred to as the barometer of the health of the economy of the country. However, many companies in the sector have little knowledge either of the costs involved in maintaining their supply chains, or of the impact of supply chain on their operations (Datascope Consulting 2008:84).

Manufacturers and suppliers are challenged to react in a flexible way to changes in customer demand (Supplychainforesight 2010), thus forcing them to hold larger inventory levels higher up in the supply chain (Datascope Consulting 2008:85). The focus is therefore not on supply chain-wide improvements. The challenges in the South African automotive industry can be attributed to poor supply chain strategies that are not matched to business strategies (Lee

2002:105). According to Fisher (1997), mismatches are the root cause of the problems plaguing many supply chains and therefore supply chain strategies that are based on a one-size-fits-all strategy will fail (Lee 2002: 106; Sun et al 2009:202). A good supply chain strategy must be aligned to a company's business strategy (Chaudhary 2008:31) since a mismatch generally leads to significant problems in business operations (Lo & Power 2010:140).

1.6 STATEMENT OF THE PROBLEM AND RESEARCH OBJECTIVES

1.6.1 Statement of the problem

Against this background, the main research question can be stated as: Do local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies?

In an endeavour to answer the main research question, the following secondary questions were answered:

- What is the extent to which supply chain best practices are implemented by local manufacturers of light vehicles in South Africa?
- What are the supply chain challenges faced by local manufacturers of light vehicles in South Africa?
- What is (are) the most important key supply chain performance indicators in contributing to optimisation of the supply chain performance of local manufacturers of light vehicles in South Africa?
- What is the supply chain strategy of local manufacturers of light vehicles based on product line characteristics?
- What is the supply chain strategy of local manufacturers of light vehicles based on manufacturing characteristic?
- What is the supply chain strategy of local manufacturers of light vehicles based on the decision drivers of SCM?
- Is there a difference with regard to supply chain best practices and strategies between manufacturers of different parent company origin in South Africa?

1.6.2 Research objectives

The main aim of the study is *"to determine whether local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies."*

The sub-objectives of the study include the following:

- To determine the extent of implementation of supply chain best practices of local manufacturers of light vehicles in South Africa
- To determine the supply chain challenges faced by local manufacturers of light vehicles in South Africa
- To determine the most important key supply chain performance indicators in contributing to optimisation of supply chain performance of local manufacturers of light vehicles in South Africa
- To determine supply chain strategies of locally manufactured light vehicles based on product line characteristics
- To determine supply chain strategies of locally manufactured light vehicles based on manufacturing characteristics
- To determine supply chain strategies of locally manufactured light vehicles based on decision drivers of SCM
- To determine if there are differences with reference to supply chain practices and strategies between manufacturers of different origin (parent companies)
- To develop a conceptual framework for determining supply chain best practices (in line with a chosen strategy) that could guide supply chain managers (locally manufactured light vehicles) in the automotive industry in South Africa in their decision making

1.7 JUSTIFICATION FOR THE STUDY

The South African automotive industry enjoys significant advantages compared with many other exporting countries. Its flexibility in producing short runs, an abundance of raw materials combined with the expertise, advanced technology and established business relationships of parent companies ensures that the South African industry increasingly adds value to the global strategies of parent companies (AIEC 2012:6). The global automotive industry is a key sector of the economy for every major country in the world. Manufacturing vehicles requires the employment of about nine million people directly in producing vehicles and the automotive components that go into them (AIEC 2012:13). According to the AIEC

(2012:13) report, it is estimated that each direct automotive job supports at least another five indirect jobs, resulting in more than 50 million jobs globally owed to the automotive industry.

The sector's contribution to the South Africa's gross domestic product (GDP) of R2 964 billion in 2011 amounted to 6.8%. A compounded, annual growth rate of 20.5% in rand value terms for completely built-up vehicles (CBUs) and automotive components exports was achieved between 1995 and 2011. Total automotive industry exports (CBUs and components) in rand value terms increased nearly seventeen fold from the R4.2 billion in 1995 to R82.2 billion in 2011. Market acceptance for South African manufactured CBUs and automotive components is high. A total of 2 133 384 vehicles were exported from South Africa between 1995 and 2011. The total nominal export value of vehicles and automotive components over this period amounted to R685.3 billion. The export growth has been accommodated by major investments in best practice assets and state-of-the-art equipment, skills upgrading, productivity gains and upgrading of the whole automotive value chain (AIEC 2012:13).

However, the industry is faced with global competition as well as diversity and variability in the nature of demand in the market. Also the delicate balance between servicing a shrinking customer base and dealing more collaboratively and productively with suppliers is a concern (Supplychainforesight 2007). To be able to meet competitive pressures and challenges, and to continue as a key growth sector in the country, the industry needs to be flexible and responsive to manage customer diversity. It is therefore imperative for supply chain managers to understand their customers' needs, and to choose and implement the right strategy for the supply chain to satisfy customer demands.

The reason for choosing to conduct the study in the automotive industry was based on the following:

(1) the contribution the industry makes to the South African economy
(2) the many supply chain challenges identified by various studies in the South African automotive industry which show that this study can make a contribution to improving the industry

1.8 RESEARCH DESIGN AND METHODOLOGY

Research design provides a blueprint for conducting research. Hence to find a solution to the research questions, the study is exploratory and descriptive in nature, and comprises two phases. The first phase of the study was a literature (exploratory) study, while the second phase was an empirical study (descriptive). In the first phase of the study, related literature was examined on SCM, the problem was defined, research questions and objectives were formulated and the justification for the study was explained. This provided a clear theoretical framework which formed the basis for the study. The outcome of the literature study was the development of a research framework to determine supply chain practices and strategies. This served as the focal point for the research framework to be used in the empirical study. The literature study covered chapters 2 to 5 of the study.

The second phase of the study was empirical (a descriptive study) and was achieved as set out below.

1.8.1 The design

The study employed both qualitative and quantitative designs. Triangulation was achieved by using structured interview questions (quantitative), while in some sections, the respondent were required to justify their responses (qualitative). The quantitative questions (structured) sought to determine the extent to which practices and strategies are implemented in the South African automotive industry. By using qualitative questions, an in-depth understanding of supply chain practices and strategies in the South Africa automotive industry was provided. The reasons for employing both designs in the study were to achieve (1) triangulation, (2) complementary results, (3) development, and (4) expansion.

1.8.2 Research strategy

The research strategy for the study was a survey. A survey is a form of research in which the researcher interacts with respondents to obtain facts, opinion and attitudes (McDaniel & Gates 2001:30). In survey research, a sample is interviewed in some form or the behaviour of respondents is observed and described in some way (Zikmund, Babbin, Carr & Griffin 2010:67). Hence a survey was the appropriate method for conducting research into determining SCM best practices and strategies among automotive manufacturers in South Africa.

1.8.3 Population and sample

The target population for the study was the original equipment manufacturers (OEMs) in the South African automotive industry (local manufacturers). In this study, the total target population was used (all light vehicle manufacturers in South Africa). A purposive sampling technique was used to determine the respondents. The intention of using purposive sampling was to focus on those who have expert knowledge about supply chain practices and operations of the product line in the automotive industry (senior supply chain managers). Specific participants for interviews were thus selected according to their strategic positions in the supply chain.

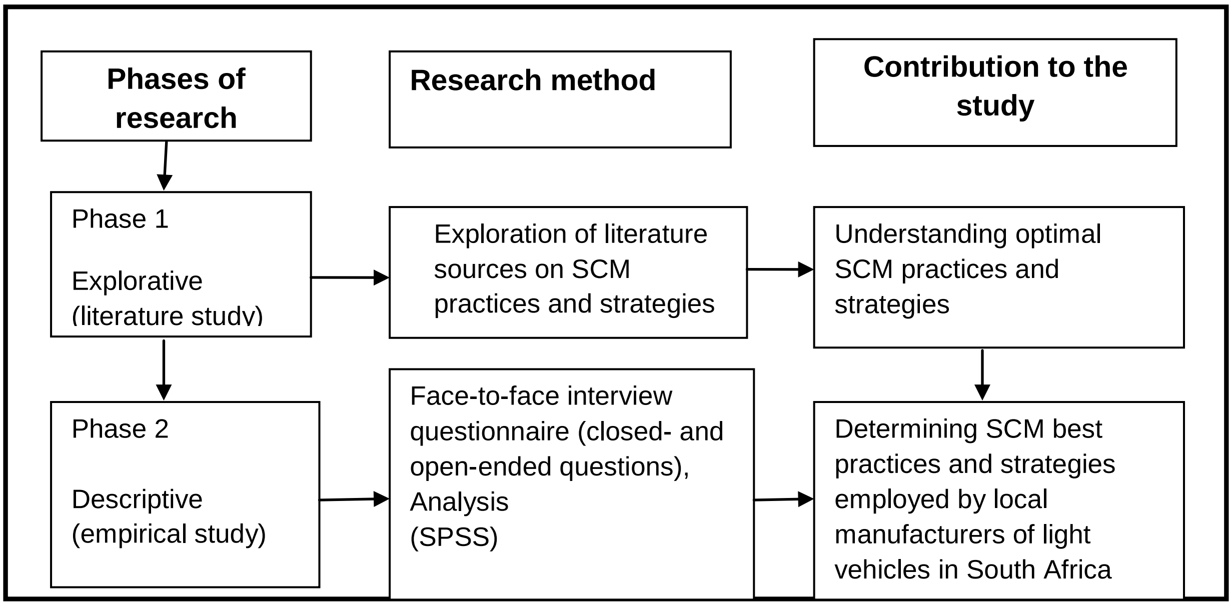
1.8.4 Data collection methods

Both primary and secondary sources of information were used. Primary data sources were collected through face-to-face interviews (empirical study), while secondary data sources were collected through extensive literature reviews (literature study). The material for the literature study was by means of sources which included books, relevant articles in journals, the Internet and papers presented at conferences. Other sources included discussion talks and meetings with supply chain practitioners and academics. The interview questions were semi-structured and measured using a five-point Likert response format with the end points, (1) "strongly disagree" to (5) "strongly agree", and (1) "no extent" to (5) to "a very great extent". A model (production line) was chosen for each manufacturer on which the interview was based. A total of 12 (N = 12) in-depth interviews were conducted for six different models. This is because supply chain strategies are determined for a particular product. A pretest (pilot test) of the interviews was conducted with two respondents from two light vehicle manufacturers to determine whether the respondents understood the questions asked. Corrections were made and the questionnaire streamlined.

1.8.5 Data analysis

After the data collection process, data was organised and analysed. The data for this study were analysed descriptively using the Statistical Package for Social Sciences (SPSS). The open-ended responses were used to give more meaning to the respondents' views on questions where they were applicable (Gray, Williamson, Karp & Darphin 2007:44). Figure 1.4 shows the different phases of the study and the expected outcome.

Figure 1.3: Phases of the research design of the study



Source: Own construction

1.9 EXPOSITION OF THE STUDY

The research study consists of eight chapters and is structured as follows:

- Chapter 1 is the **orientation:** the chapter introduces and provides background to the study. It deals with the statement of the problem; justification for the study; research objectives; research questions; the importance of the study; the research methods; the preliminary literature review; delimitation of the study; and exposition of the study chapters.
- Chapter 2 is the **theoretical framework of supply chain management** and provides the definition and background of supply chain management; supply chain integration practices, the supply chain relationship, processes in the supply chain; and decision areas of supply chain.
- In chapter 3 **supply chain management practices in the automotive industry** are discussed**.** The chapter provides the background to the global automobile industry, the state of business and drivers of change in the automobile industry; maps the global automotive industry structure; outlines the South African automobile industry and its global trends and automotive supply chain practices; and examines challenges as well as performance indicators.
- **Supply chain management strategies** are discussed in chapter 4. The chapter explores strategies and the different configurations of developing a supply chain

strategy for different market segments. The chapter concludes by presenting the different positions where supply chain strategies can be separated.

- Chapter 5 presents **the framework for determining supply chain practices and strategies**. The chapter demonstrates the optimal characteristics of the various supply chain practices as well as a framework for the chosen strategies.
- Chapter 6 contains the **research design and methodology.** The chapter presents the background to the study area; research design; research instruments, sampling procedures; data collection; data analysis; research validity and reliability; ethical considerations; and the trustworthiness of the study.
- Chapter 7 deals with the **practices and strategies employed in the South African automotive industry.** The chapter presents analyses and interprets the supply chain management practices in the automobile industry based on the findings.
- Chapter 8 focuses on the **discussion, conclusion and recommendations of the study**. The chapter reflects on the research problem and objectives, discusses the research questions, conclusions, recommendations and limitations of the research findings and contributions and explores avenues for further research.

CHAPTER 2

THEORETICAL FRAMEWORK FOR SUPPLY CHAIN MANAGEMENT

2.1 INTRODUCTION

Chapter 1 introduced the study. In that chapter, the problem statement was defined and the justification for the study provided. Chapter 2 presents the theoretical framework for SCM. It provides the definition of and background to SCM, supply chain integration, supply chain relationships, decision areas in SCM as well as processes in SCM. The chapter contributes to an understanding of the concept and practices of SCM in determining the optimal supply chain practices and strategies employed by local manufacturers of light vehicles in the South African automotive industry.

2.2 DEFINITION OF AND BACKGROUND TO SUPPLY CHAIN MANAGEMENT (SCM)

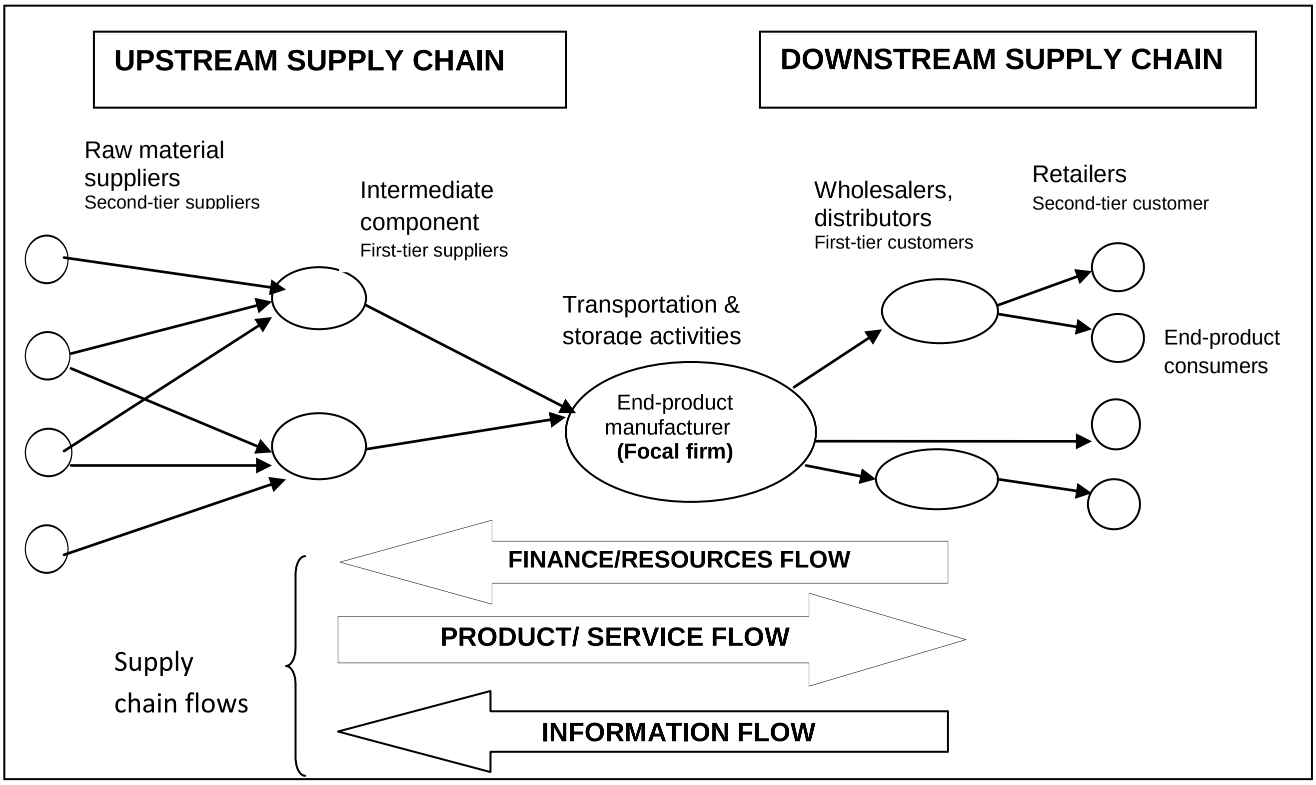
This section of the chapter presents the definition of and background to SCM. In the course of the chapter, SCM is defined, the evolution of SCM discussed and supply chain practices explained.

2.2.1 Definition of a supply chain and SCM

A supply chain includes all activities, functions and facilities (directly or indirectly) in the flow and transformation of goods and services from the material stage to the end user (Sherer 2005:79; Moon & Kim 2005:394). According to Chopra and Meindl (2013:13), a supply chain consists of all parties involved directly or indirectly in fulfilling a customer request. It involves the network of organisations from upstream (supplier end of the supply chain) to downstream (customer end of the supply chain) linkages (Mangan, Lalwani, Butcher & Javadpour 2012:10). It links organisations in the upstream as well as the downstream flows of materials and information and comprises a physical element and an information element (Monczka, Trent & Handfield 2005:9). A typical supply chain may include suppliers, manufacturers, distributors, retailers and customers (Chopra & Meindl 2013:14).

The supply chain starts with firms extracting raw materials from the ground. The raw materials are sold to raw materials suppliers (Harrison & Van Hoek 2011:6). These firms, acting on purchase orders and the specifications they have received from components manufacturers, turn the raw materials into materials that are used by their customers. The component manufacturers, responding to orders and specifications from their customers (the final product manufacturers) make and sell intermediary components. The final product manufacturers (eg General Motors) assemble the finished products and sell them to wholesalers or distributors, who then resell them to retailers as their product orders are received (Wisner et al 2012:6). Figure 2.1 represents a generic supply chain framework.

Figure 2.1: Framework for a generic supply chain



Source: Wisner, Tan & Leong (2008:7)

As indicated in figure 2.2, within a supply chain, there are characteristics and decisions that form part of the value-adding process. These characteristics and decisions are integrated into the supply chain process as enablers which form part of a value-adding process (Fawcett et al 2007:8). This value-adding process can be termed “SCM”.

There are various definitions of SCM. Based on the definition of the Institute for Supply Management, adopted by Fawcett et al (2007:8), “SCM is the design and management of seamless, value-added process across organisational boundaries to meet the real needs of the end customer”. According to the Council of SCM Professionals (CSCMP) definition (2010), SCM involves planning and controlling of all processes involved in procurement, conversation, transportation and distribution across the supply chain (Harrison & Van Hoek 2011:7). Christopher (2005:5) defines SCM as “the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole”. Gansler et al (2004: 8) note that SCM is the management and control of all materials, funds and related information in the logistics process from the acquisition of raw materials to the delivery of finished products to the end user. Hugo et al (2004:5) define SCM “as the management philosophy aimed at integrating a network of upstream linkages (sources of supply), internal linkages inside the organization and downstream linkages (distribution and ultimate customer) in performing specific processes and activities that will ultimately create and optimize value for the customer in the form of products and services which are specifically aimed at satisfying customer demands”.

Generally, SCM involves relationships and managing the inflow and outflow of goods, services and information (network) between and within producers, manufacturers and consumers (Samaranayake 2005:48; Gripsrud, Jahre & Persson 2006:645). It can be viewed from three different angles which is evident in different definitions as: SCM as a management philosophy; the implementation of the SCM as a management philosophy; and a set of management processes (Klemencic 2006:13; Lambert 2006:13). Therefore, SCM involves the management of the activities of the supply chain to foster the emergence of a value system. It includes coordination of and collaboration with processes and activities across different functions such as marketing, sales, production, product design, procurement, logistics, finance and information technology within the network of the organisation (Blos, Quaddus, Wee & Watanabe 2009:247).

2.2.2 Evolution of SCM

There are discrepancies about the origin and evolution of the concept of SCM. While some researchers view it as a fulfilment of the activities of integration, evident in early definitions, others see it as a new and bold concept in literature (Ballou 2007:337). Authors such as Burt et al (2010:3), Hugo et al (2004:3) and Sherer (2005:78) have acknowledged that SCM was a dramatic change in business during the 1990s and that most of the basic principles underlying SCM developed over at least four decades. Furthermore, as noted by Ballou (2007:338), SCM developed from logistics with other functional areas such as finance, marketing, operations making an equally important contribution. Between the 1960s and 1970s, what is known as SCM today was known as materials logistics management or simply materials management. According to Wisner et al (2008:12), management functions were grouped together in material flow. Purchasing, operations and distribution were integrated to improve customer service and to decrease operating costs. During this period, the emphasis was on physical distribution with a view to improving the availability of products to customers (Hugo et al 2004:4).

Some authors are of the opinion that SCM developed from different experiences in purchasing in a changing market. Purchasing was responsible for a representative component of the cost of goods sold, and a large share of businesses' quality problems. Purchasing management became a proactive concept and training and education were offered to equip professionals to meet the demand of the challenge posed by constantly fluctuating environment, globalisation, major technological advancements, automation in production processes, outsourcing and inflation. Also, the growth of materials management concepts during this period combined related functions such as purchasing, inventory control, receiving and warehousing under one authority. This led to delays from the supply market and customer needs that could not be met in time (Burt et al 2010:15). Sherer (2005:78) noted that prior to the 1980s, most organisations worked fairly independently of their suppliers. It was never historically possible to have suppliers and customers integrated into the supply chain as partners.

By the 1980s, there was substantial pressure on manufacturers to become more flexible and be able to adapt manufacturing processes quickly to ever-changing demands (Hugo et al 2004:4). Between the 1980s and 1990s, there was a shift to integrate various functions including SCM (Wisner et al 2012:12). The integration led to higher profit margins and SCM best practices were adopted. During the 1990s, the focus of logistics had changed from internal efficiency to external relations between parties in the supply chain (Hugo et al 2004:4). The late 1990s saw the importance of SCM widely recognised (Sherer 2005:78). The power of SCM lies in supply chain integration. The integration of customers into the supply chain improved the information flow along the supply chain. Customer information provided insight into the needs of the customer. The further away the members in the supply chain are from the end user, the less they know about the needs of the customer. The less information the supply chain members have about customers' needs, the higher the level of uncertainty in the supply chain and the more difficult the planning process.

However, as indicated by Shah (2009:6), the evolution of SCM can be classified into three revolutions and can be summarised as follows:

2.2.2.1 The first revolution (1910–1920): the Ford supply chain

The first major revolution was staged by the Ford Motor Company which had managed to build a tightly integrated chain. The Ford Motor Company owned every part of the chain right from the timber to the rails. Through its tightly integrated chain, it could manage the journey from the iron ore mine to the finished automobile in 81 hours, producing any colour, as long as it was black; and any model, as long as it was a Model T. Ford innovated and managed to build a highly efficient, but inflexible supply chain that could not handle a wide product variety and was not sustainable in the long run. General Motors, however, understood the demands of the marketplace and offered a wider variety in terms of automobile models and colours. Ford's supply chain required a long time for set-up changes and, consequently, it had to work with a very high inventory in the chain.

2.2.2.2 The second revolution (1960–1970): the Toyota supply chain

Towards the end of the first revolution, the manufacturing industry saw many changes, including a trend towards a wide product variety. To deal with these changes, firms had to restructure their supply chains to be flexible and efficient. The supply chains were required to deal with a wider product variety without holding too much inventory. The Toyota Motor Company successfully addressed all these concerns, thereby ushering in the second revolution. The Toyota Motor Company came up with ideas that allowed the final assembly and manufacturing of key components to be done in-house. The bulk of the components were sourced from a large number of suppliers who were part of the *keiretsu* system. *Keiretsu* refers to a set of companies with interlocking business relationships and shareholdings. The Toyota Motor Company had long-term relationships with all the suppliers. These suppliers were located very close to the Toyota assembly plants.

2.2.2.3 The third revolution (1995–2000): the Dell supply chain

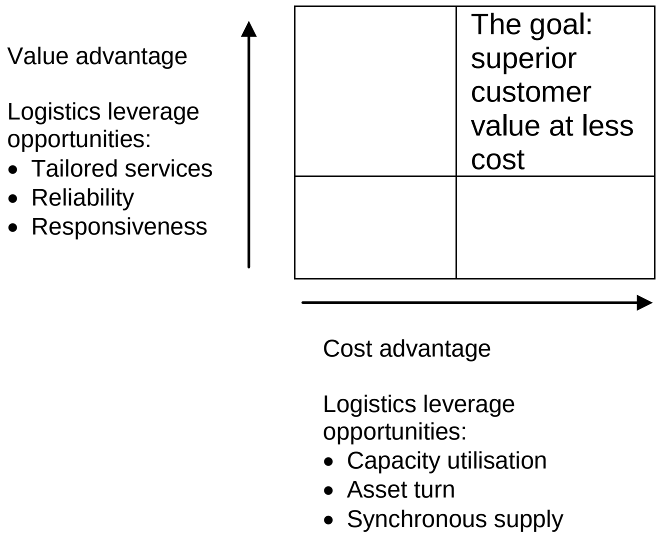
With advances in information technology (IT), Dell Computers allowed customers to customise their computers. Dell allowed customers to configure their own PCs and track the same in their production and distribution systems. Unlike the Toyota supply chain, Dell did not believe in long-term relationships with suppliers. Dell believed in working with world-class suppliers that would maintain their technology and cost leadership in their respective fields. Dell maintained medium-term relationships with suppliers, where the suppliers were always on test. Because of advances in IT, Dell could integrate the suppliers electronically, even if they were partners only for the medium term. At Dell, the trigger for supplier orders was the actual orders by customers, and not forecasts. This helped Dell to reduce inventory significantly, allowing it to respond to any changes in the marketplace. Since its suppliers were electronically integrated and it did not want rigidity in the chain, Dell did not see any advantage in locating suppliers close to its assembly plants. With increased use of IT in supply chain management, it became possible to achieve operational integration even with those suppliers with whom the firm did not have long-term relationships.

2.2.3 Objectives of SCM

The objective of SCM is to maximise value in the supply chain. The value a supply chain generates is the difference between what the final product is worth to the customer and the costs the supply chain incurs in filling the customer's request (Chopra & Meindl 2010:22). SCM is about competing on value, collaborating with customers and suppliers to create a position of strength in the marketplace based on value derived from end consumer (Chopra & Meindl 2013:23). Value is not inherent in products or services, but instead is perceived or experienced by the customer (Handfield et al 2009:11). The ultimate goal of a SCM process is to create customer and shareholder value, and it is thus often called a value delivery system. This can be achieved by pursuing technology and teamwork to build efficient and effective processes that create value for the end customer (Fawcett et al 2007:8).

Firms that optimise their value chain activities vis-à-vis the competition stand a better chance of leveraging valuable capabilities into suitable competitive advantage (Prajogo, McDermott & Goh 2008:615). According to Handfield et al (2009:11), SCM has continued to be adopted by organisations as the medium for creating and sustaining competitive advantage (Fawcett et al 2008:35). Competitive advantage is built upon a well-planned and executed SCM strategy that is sustainable (Iskanius 2006:78). Competitive advantage belongs to those supply chains that can activate concurrent business processes and core competences that merge infrastructures, share risks and costs, leverage the shortness of today's product life cycle, reduce time to market and gain and anticipate new vistas for competitive leadership. In the competitive context, successful companies either have a productivity advantage (or cost advantage) or value advantage, or ideally, a combination of these two (Iskanius 2006:78). Therefore, the prospect of gaining value advantage in the marketplace is through superior customer service (Christopher 2005:12). Figure 2.2 below summarises the process of gaining a competitive advantage in the supply chain.

Figure 2.2: Gaining a competitive advantage in the supply chain



Source: Christopher (2005:12)

Hence organisations that will be leaders in the markets of the future will be those that have sought and achieved the twin peak of excellence, that is, they have gained both cost leadership and service leadership. This can be achieved through integration of processes in the supply chain.

2.3 SUPPLY CHAIN INTEGRATION (SCI)

This subsection of the chapter presents an overview of SCI. SCM requires an integration of all the components involved in a combination of business processes within and across organisations (Samaranayake 2005:47). Integration is now widely considered the core of successful SCM (Richey, Chen, Upreti, Fawcett & Adams 2009:826). This is because the implementation of SCM needs the integration of processes from sourcing, to manufacturing and distribution across the supply chain (Richey et al 2009:826).

2.3.1 Definition of SCI

SCI involves collaborating across functional departments, suppliers, and customers to arrive at mutually acceptable outcomes (Boon-itt & Wong 2011:254). According to Monczka et al (2005:98), integration is the process of incorporating or bringing together different groups, functions or organisations, either formally or informally, physically or by mean of information technology, to work jointly and often concurrently on a common business-related assignment or purpose. Stonebraker and Liao (2006:34) assert that SCI is an extension and application of vertical integration theory. Richey et al (2009:827) refer to SCI as a formation of network encompassing elements of supply chain which are the suppliers, customers and the company. Harrison and Van Hoek (2011:257) note that what drives integration is the need to design the supply chain to meet the needs of the customer.

Thus, SCI incorporates different groups, functions or organisations either formally or informally, physically or by information technology, to work jointly and often concurrently on a common business related assignment or purpose (Handfield et al 2009:114). In this regard, collaboration is a key element of SCI (Zolait, Abrahim, Chandran, Pandiyan & Sundram 2010:211). This is because strategic collaboration is required to promote cross-functional communication and joint efforts (Kannan & Tan 2010:211) so that the supply chain is able to achieve on-time delivery (Boon-itt & Wong 2011:254). The level of SCI determines the relationships between the members of the supply chain (Lambert 2006:22). This requires people to create a common understanding of the end goal or purpose (Song & Panayides 2007:2). According to Richey et al (2009:827), SCI is a competitive strategy used by companies to achieve greater coordination and collaboration between supply chain partners.

2.3.2 Types of SCI

There are basically two types of integration processes, namely internal integration and external integration which can be divided into four stages of SCI.

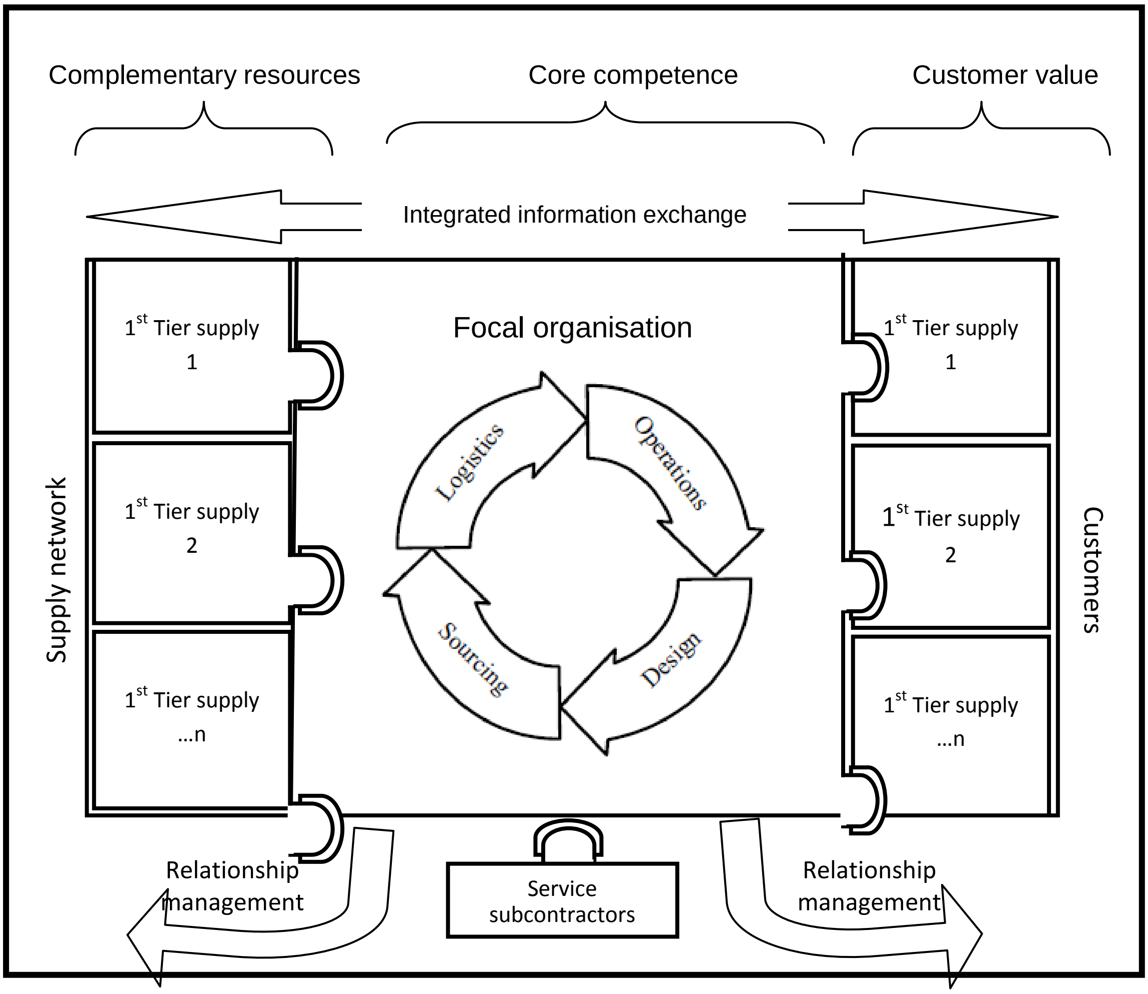
2.3.2.1 Internal SCI

SCI is required "internally" within and across functions and "externally" across suppliers and customers (Harrison & Van Hoek 2011:258). The internal supply chain is that portion of the supply chain that occurs in an individual organisation and can be complex (Handfield & Nichols 2002:48). The key to effective SCI lies in focusing initially on internal SCI in the organisation and then extending the process to include suppliers and customers (Saxton 2006:58). In internal integration, all the related activities in an organisation work together as a single function (Waters 2009:138). Internal SCI requires every function in the business to act in harmony, and this is a prerequisite for progressing towards external SCI (Saxton 2006:95). The integration of all internal functions from materials management to production, sales and distribution is paramount to meeting customer requirements at the lowest total system cost (Handfield et al 2011:118). Thus, internal integration is characterised by full systems visibility across functions such as procurement, production, logistics, marketing, sales and distribution (Boon-itt & Wong 2011:254).

2.3.2.2 External SCI

The external supply chain includes suppliers and customers (Handfield & Nichols 2002:49). According to Sundaram and Mehta (2002:537), external integration refers to the integration of activities external to the organisation across the supply chain. It extends the scope of information sharing and collaboration to include suppliers and customers (Boon-itt & Wong 2011:255). Figure 2.3 illustrates a framework for internal and external supply chain integration. On the demand side of a supply chain, through customer integration, firms will penetrate deep into the customer organisation to understand its product, culture, market and organisation in such a way that they can respond rapidly to the customer's needs and requirements. Forward physical flow suggests applying customer integration to enable just-in-time (JIT) delivery and postponement strategy. With increased visibility, customer integration will further stimulate collaboration in demand planning – otherwise, owing to the lack of information sharing from one end of the supply chain to the other, there will be tremendous inefficiencies in customer service (Boon-itt & Wong 2011:255). Figure 2.3 illustrates the most common supply chain approach, namely the focal organisation and its integration with wider supply chain.

Figure 2.3: Internal and external supply chain integration

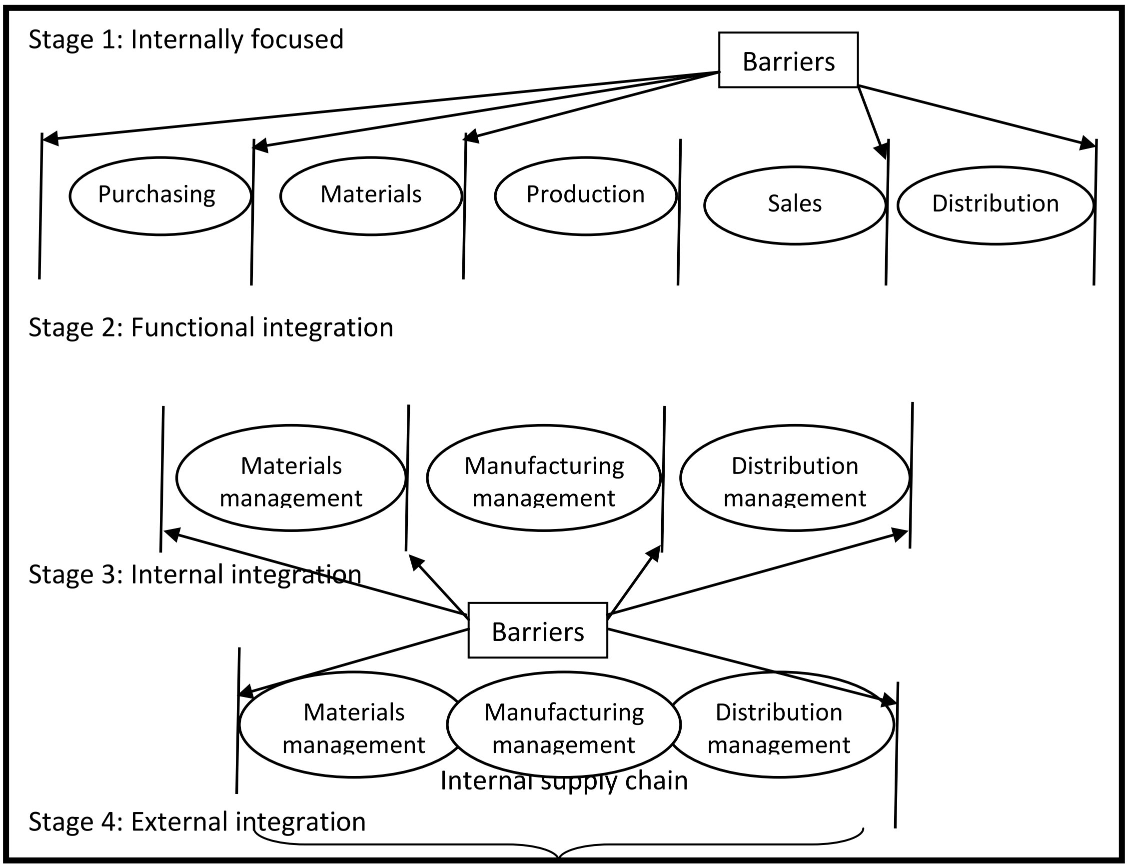


Source: Childerhouse, Deakins, Böhme, Towill, Disney & Banomyong (2011:533)

2.3.3 Stages of development in SCI

Successful SCI is tied to a wide range of cultural variables and professional functions (Stonebraker et al 2006:36). Christopher (2005:18) acknowledges that supply chain integration has evolved from functional dependence where each business function existed in complete isolation from other business functions. As mentioned above, the two basic types of integration can be divided into four stages of SCI and, as mentioned earlier, each stage involves further development (Childerhouse & Towill 2003:111). The four stages of SCI are (1) internally focused (or baseline organisation), (2) functional integration, (3) internal integration and (4) external integration (Wisner et al 2012:263). At each stage of SCI, product flows become smoother and inventory holding becomes decreases. The four stages of SCM integration are illustrated in figure 2.4.

Figure 2.4: Developmental stages towards an integrated supply chain



Source: Christopher (2005:19); Wisner et al (2012:265)

2.3.3.1 Stage 1 of SCI: baseline organisation

In stage 1, the organisation is internally focused, functions are managed separately and performance monitoring is based on achieving departmental goals (Wisner et al 2012:264). This causes a functional silo effect. This silo effect causes the organisation to be reactive and short-term goal oriented (Wisner et al 2012a:264). At this stage, no internal functional integration occurs independently and often incompatible control systems and procedures will cover the various organisational functions (Handfield et al 2011:217). According to Christopher (2005:18), decision making in this stage occurs through a series of modules operated by various members of the supply chain. There are separate modules for decision making at every echelon of the supply chain (Sundaram & Mehta 2002:539) and the supply chain and its practices are unstructured and ill-defined.

2.3.3.2 Stage 2 of SCI: functional integration

In the second stage, according to Wisner et al (2012:264), the focus has started to shift towards an emphasis on the flow of products and information through the organisation to achieve production efficiencies and to reduce throughput times. The organisation focuses on cost reduction and not performance improvement. In spite of these efforts, SCM costs remain high (Lockamy III & McCormack 2004:275). Organisations recognise the need for at least a limited degree of integration between adjacent functions (Christopher 2005:18). Discrete business functions still exist in stage 2, each of which is buffered by inventory (Childerhouse & Towill 2003:112). Most organisations at this stage do not leverage scale across the entire organisation (Birou 2006:294). Organisations still focus inwardly on products and are reactive towards their customers. Also, collaboration between functions or business units is resisted and overcoming these functional silos takes considerable effort owing to these boundary concerns and the mentioned competing goals (Lockamy III & McCormack 2004:275).

2.3.3.3 Stage 3 of SCI: internal integration

In stage three, internal integration of goods and information has been achieved (Wisner et al 2012:264). In internal integration all the related activities in an organisation work together as a single function (Waters 2009:138). Internal integration requires all members in an organisation to use the same information systems that span the organisation (Handfield, Monczka, Giuinipero & Patterson 2011:675). As the focus turns to integrating the organisation to best provide end-to-end product delivery, the functional silo mentality begins to disintegrate (Birou 2006:294). This stage is characterised by a comprehensive integrated planning and control system. It also involves cooperation between intra-organisational functions, suppliers and customers take the form of teams that share common SCM measures and goals reach horizontally across the supply chain (Lockamy III & McCormack 2004:276). As such, some informal channels of integration may be developing between traditionally separate functions in the organisation, including, for example, purchasing, engineering, manufacturing, marketing and accounting to form multifunctional teams (Handfield et al 2011:224).

2.3.3.4 Stage 4 of SCI: external integration

This stage of integration development is characterised by efforts to broaden the organisation's supply chain influence beyond immediate or first-tier suppliers and customers (Wisner et al 2012:265). According to Sundaram and Mehta (2002:537), external integration involves integration of activities external to the organisation across the supply chain. External integration thus represents true SCI in that the concept of linkage and coordination that is achieved in stage 3 is now extended upstream to suppliers and downstream to customers (Christopher 2005:18). In this stage, total collaboration between the various links in the supply chain is achieved. Each organisation is connected to the decision-making process (Sundaram & Mehta 2002:539). In stage 4 of SCI, new metrics are introduced in areas such as on-time delivery, fill rates and returns to underscore the importance of satisfying customers. Network partners begin to use activity-based costing and balanced scorecards to turn the supply chain into a value chain of allies working together towards the same strategic objectives. With information being shared electronically, network members can more readily identify opportunities to achieve higher performance levels. Joint teams are established to find solutions to specific customer problems (Birou 2006:295). As a result, cost and time are reduced, and this adds value for the customer (Hines 2006:81).

2.4 SUPPLY CHAIN RELATIONSHIPS

A core principle in SCM is that not all relationships are created equally (Fawcett et al 2007:346) and successful business relationships are vital for firms in supply chains (Su, Song, Li & Dan 2008:263). As indicated by Wilding and Humphries (2006:311), close long-term relationships between customers and suppliers have a beneficial impact on performance. Customer and supplier commit to continuous improvement and shared benefits by exchanging information openly and they resolve problems by working together. Supply chain relationships are probably the most fragile and the most susceptible to breaking down (Fawcett et al 2007:348). A poor relationship in any part of the supply chain can have disastrous consequences for all members of the chain. Communication between all businesses is therefore vital.

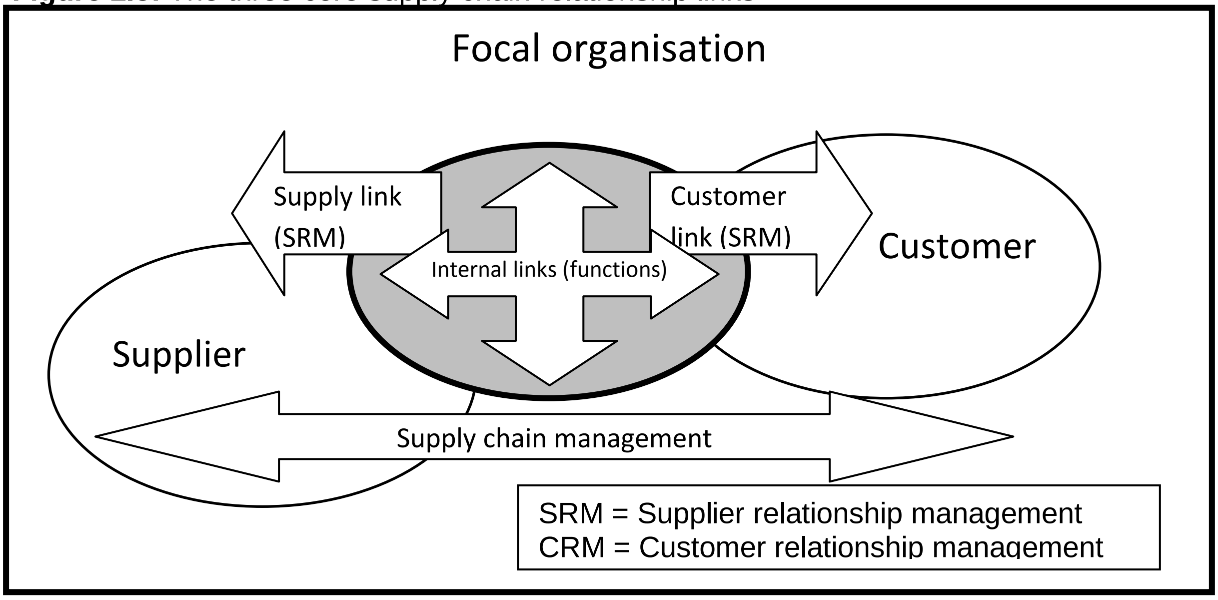
The next subsection discusses the relationships in the supply chain, the supply chain relationship spectrum as well as power and trust in supply chain relationships.

2.4.1 Links in supply chain relationships

There are several links or relations between buyers and sellers in a supply chain or supply chain network. Selecting the right supply chain partners and successfully managing these relationships over time is strategically important (Wisner et al 2012:75). In a supply chain, there are external relationships between a supplier and the buying organisation; internal relations within the buying organisation between the relevant functions as well as external relations between the buying organisation (which now becomes the supplier) and the customer (Wisner et al 2012:76). Thus, every buying organisation in turn becomes the supplier to the next buying organisation in the supply chain until the end customer is reached. The links between the buying organisation and its direct suppliers and customers are external ones. The ability of an organisation to connect these two external links through its internal organisation determines the effectiveness of its total supply chain (Leenders, Johnson, Flynn & Fearon 2006:494 & 495).

According to Lambert (2006:27), customer relationship management (CRM) and supplier relationship management (SRM) provide the critical external linkages throughout the supply chain. CRM is the SCM process that provides the structure for the way relationships with customers are developed and maintained (Lambert 2006:25). Wisner et al (2012:361) notes that CRM becomes necessary as soon as a company finds a market and some customers for its products and services. SRM, however, is the process that defines how a firm interacts with its suppliers and is a mirror image of CRM (Mettler & Rohner 2009:59). Just as a firm needs to develop relationships with its customers, it also needs to foster relationships with its suppliers. The desired outcome is a win-win relationship where both parties benefit (Mettler & Rohner 2009:59). Hence when viewing the external relationships between buyers and sellers from the customer organisation, SRM is the SCM process that provides the structure for the way in which relationships with suppliers are developed and maintained (Lambert 2006:115). Figure 2.5 depicts the relationships and links in the supply chain.

Figure 2.5: The three core supply chain relationship links



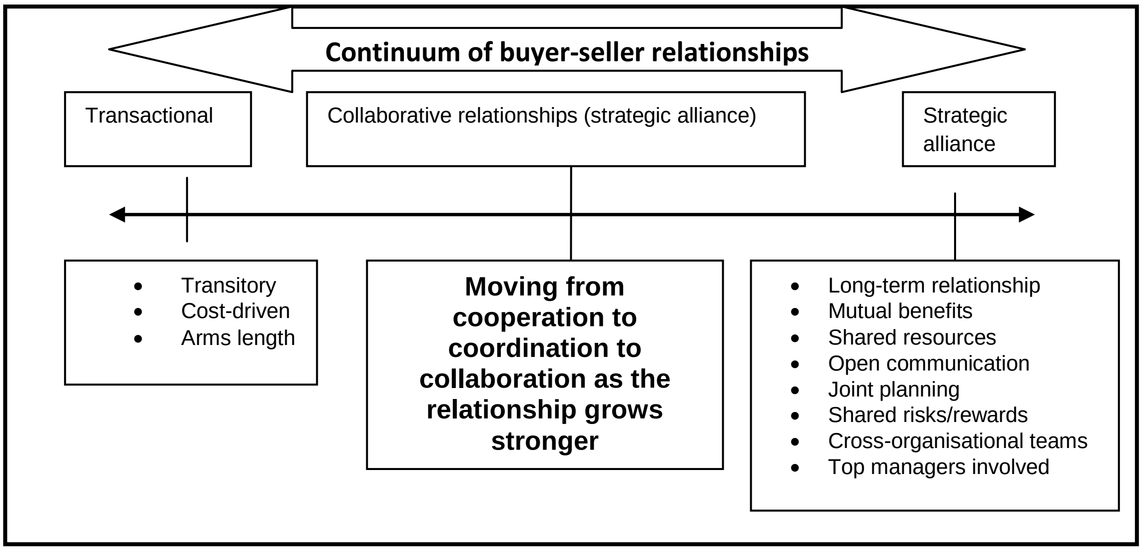
Source: Lambert (2006:27)

As indicated in figure 2.5, CRM and SRM fit into the external relations between customers and suppliers: one relationship between buyer and seller will include CRM from the supplier's point of view and SRM from the buyer's point of view.

2.4.2 Supply chain relationship spectrum

Various variables contribute to or define the type of relationship between the players in the supply chain (Fawcett et al 2007:347). A combination of these variables gives rise to different buyer-supplier relationship structures be they collaborative or arms-length type of relationships (Emmett & Crocker 2006:127). According to Burt et al (2010:65), buyer-supplier relationships have evolved from being transactional to collaborative to alliance based. In South Africa, for example, the automotive assemblers hold a strong position in the automotive industry and because of this, in the past, this strength led to adversarial relationships with component suppliers and sellers (Naude 2009). Figure 2.6 depicts the types or spectrum of supply chain relationship in a supply chain.

Figure 2.6: Relationship intensity spectrum



Source: Adapted from Fawcett et al (2007:347); Burt et al (2010:66)

The spectrum of relations in supply chain(s) ranges from an integrated hierarchy as in the vertical firms to pure market view (Hines 2006:177). The various types of relationships are now discussed.

2.4.2.1 Transactional relationships

The most basic common types of relationship in the supply chain are transactional relationships (Burt et al 2010:66). Also known as arm's-length, this relationship represents the majority of a company's supply chain relationships (Fawcett et al 2007:349), which is neither good nor bad. This is because transactional relationships do not receive much managerial time. They are managed for efficiency and are often transitory. As a rule, commodities are being purchased and the relationships themselves are often treated as if they too are commodities (Hugo & Badenhorst-Weiss 2011:86). The focus is on cost. Suppliers are under intense pressure to minimise both product and relationship costs. Reverse auctions and global sourcing are some of the tools used to keep costs down (Fawcett et al 2007:346). Burt et al (2010:66) advocate that in this relationship, neither party is especially concerned with the well-being of others. Virtually all buying firms have transactional relationships (Baily, Farmer, Crocker, Jessop & Jones 2008:211). Lysons and Gillingham (2003:378) observe that transactional relationships can either be a one-off transaction or on-going transactions. Usually a one-off transaction is for a specific item for a specific use, and is not expected to be repeated.

Some of the characteristics of transactional relationships include the following: lack of interest by both parties about the other party's well-being; there is one or a series of independent deals and little or no basis exists for collaboration; and costs, data and forecasts are not shared. Also, price is the main focus of the relationship; there is a minimum purchasing time and energy is required to determine prices. Transactional purchases lend themselves to e-procurement and reverse auctions (Burt et al 2010:67). Transactional relationships have some advantages and disadvantages. With reference to the advantages, they require less time and effort is spent on procurement to determine price, because the market forces of supply and demand determine the price. Lower skills levels of purchasing staff are required. The disadvantages of transactional relationships include the following: possible communication difficulties; substantial investment in expediting and checking incoming quality and timely delivery; inflexibility when flexibility may be required, particularly when changing technology and changing market conditions require flexibility in supplier/buyer relationships; delivery problems; minimum services provided by suppliers; supply disruptions; and reluctance by the supplier to invest time and energy in the development of the potential buyer's products (Burt et al 2010:67).

2.4.2.2 Collaborative relationships (or supply chain partnerships)

The development of partnerships (or collaborative relationships) invariably involves the development of interorganisational relationships (Leat & Revoredo-Giha 2008:398). Supply chain partners move away from the transactional spectrum of the continuum towards more intense collaborative relationships as they become aware of their interdependence and the necessity for cooperation (Burt et al 2010:69), thus strengthening supply chain integration and providing sustainable competitive advantage (Lambert 2006:167). Collaboration has been referred to as the driving force behind effective SCM. Collaboration can be defined as "the process by which two or more parties adopt a high level of cooperation to maintain a trading relationship over time" (Monczka et al 2005:103). The rationale behind collaboration is that a single organisation cannot successfully compete by itself (Harrison & Van Hoek, 2011:271).

While transactional relationships (arms-length) represent an appropriate option in many situations, there are times when a closer, more integrated relationship, referred to as a partnership, provides significant benefits to both the buying and selling organisations (Lambert 2006:169; Baily et al 2008:210 & 211). Simple customer-supplier relationships may evolve into more formal partnerships over time, when commitment between the buying and supplying organisations develops into enhanced collaboration in creating new value for the ultimate customers (Maheshswari, Kumar & Kumar 2006:279). Burt et al (2010:68) hold that the basic difference between transactional and collaborative relationships is recognition of interdependency of and necessity for cooperation. Collaborative relationships look out for their “friends” and not their opportunistic customers. Both customers and suppliers who see one another in terms of long-term relations and respect and would probably support one another in difficult times. However, Burt et al (2010:68) state that the main weakness of such relationships is the amount of human resources and time and energy needed to build and manage them.

Collaborative relationships have the ability to, amongst others, achieve cost savings and to reduce duplication of efforts by the organisations involved. For suppliers, collaborative relationships with industry leaders can enhance operations and prestige and provide stability in unstable markets. For buyers, collaborative relationships can improve profitability, reduce purchasing costs and increase technical cooperation (Lambert 2006:170). Buyers can also enjoy the benefits of early supplier involvement, reduced time to market and improved quality (Hines 2004:178 & 179; Burt et al 2010:69). Continuous improvement is far easier to implement and manage with recognised interdependence and cooperation. The end objective of continuous improvement is a reduction in total cost, improved quality and timeliness (Burt et al 2010:69). Different cooperative relationships have been identified as partnerships, alliances, joint ventures, network organisations, franchises, licence agreements, contractual relationships, service agreements and administered relationships (Burt et al 2010:69) as indicated in figure 2.6 above.

2.4.2.3 Strategic alliance relationships

Strategic alliance is a core building block for winning supply chain teams, closely scrutinised and carefully managed (Fawcett et al 2007:351). These relationships are characterised by intensive and relatively open communication, and are supported by linked information systems. Information about production schedules and technology plans is shared. Organisations must protect sensitive customer and supplier information, making sure that it is kept strictly confidential. Mutual respect and benefits govern these relationships. Engineering resources and innovation ideas are often shared. Cross-organisational teams drive cooperative planning to solve problems and develop process and product technologies (Fawcett et al 2007:347). Strategic alliances share a significant level of operational integration (Lambert 2006:170). Each party views the other as an extension of its own organisation (Lambert

2006:170). In this situation, independent organisations view their partners as difficult to replace. Strategic alliances are reserved for suppliers or customers who are critical to an organisation's long-term success (Lambert 2006:170). When supply chain partners achieve the greatest degree of collaboration, they form strategic alliances (Cohen & Roussel 2005:146).

The purpose of an alliance is to achieve a common goal that each organisation could not easily accomplish alone. Alliances encompass a variety of agreements, whereby two or more organisations agree to pool their resources to pursue specific market opportunities (Mentzer 2004:50). Other opportunities include risk and reward sharing, reduction in coordination and transaction costs, ability to concentrate on core competency and rapid response to market needs (Maheshwari et al 2006:278). Strategic alliances are typically multifaceted, goal oriented and long term (Lysons & Farrington 2006:97 & 98). Important attributes of strategic alliances include the following (1) having expectations clearly stated, understood and agreed upfront; (2) collaboration on supply chain design and product and service strategies; (3) having top management of partnering organisations interface on a regular basis; and (4) having compatible IT systems (Lysons & Farrington 2006:98). Relationships vary and depend on their levels of trust, commitment, mutual dependence, organisational compatibility, vision, leadership, and top management support (Wisner et al 2012:76). Table 2.1 depicts the characteristics across the supply chain relationship spectrum.

Table 2.1: Characteristics of buyer-supplier relationships

Continuum of supply chain relationships		
Transactional relationships		**Strategic alliances**
High potential problems	***Communication***	Systematic approach to enhance communication
Low	***Competitive advantage***	High
Independence	***Connectedness***	Interdependence
Little	***Continuous improvement***	A focus
Few	***Contributions to new product development***	Many – early supplier involvement
Low	***Difficulty of exit***	Difficult – high impact
Short	***Duration***	Long
Reactive	***Expedition***	Proactive
Price	***Focus***	Total cost
Little or none	***Level of integration***	High or total
Low	***Level of trust***	High
Many	***Number of suppliers***	One or few
No	***Open books***	Yes
Incoming inspection	***Quality***	Design quality into system
Inward looking	***Relations***	Concern with each other's well-being
Few – low skill level	***Resources***	Professional
Minimal	***Service***	Greatly improved
No	***Shared forecasts***	Yes
Possible	***Supply disruptions***	Unlikely
No	***Technology inflows***	Yes
Tactical	***Type of interaction***	Strategic synergy

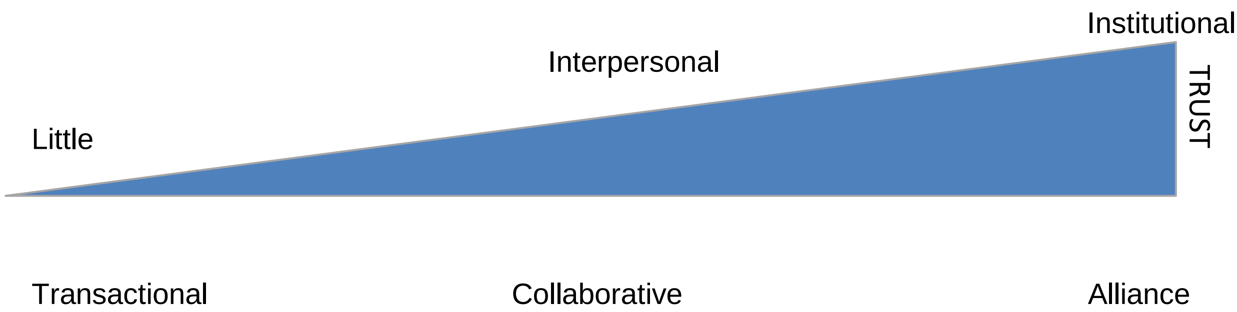
Source: Burt et al (2010:66); Handfield et al (2009:123)

2.4.3 Trust in supply chain relationships

A well-developed, long-term, co-operative working relationship with suppliers is based on trust (Nyaga, Whipple & Lynch 2010:104). Trust is often referred to as an essential element of successful supply chain partner relationships (Laeequddin, Sahay, Sahay & Waheed 2012:550). It is the extent to which relationship partners perceive each other as credible and benevolent (Su et al 2010:266). According to Chopra and Meindl (2010:496), trust involves a belief that each supply partner is interested in the other's welfare and will not take actions without considering itsr impact on the other partners (Chopra & Meindl 2010:496). Trust is described as the foundation for effective SCM because it promotes collaboration, risk taking and both shared information and shared resources (Gust & Fedorowicz 2008:457). Trust in the supply chain ultimately helps improve performance and is a key factor in forming strategic partnerships and alliances (Wisner et al 2012:76). The future of SCM depends on managers' willingness to commit to cultivating greater trust in alliance and other SC relationships. Hence trust is at the heart of managing risk and a prerequisite in supply chain (Laeequddin et al 2012:551).

Trust has numerous antecedents, including open information sharing, commitment, clear expectations and follow through (Wisner et al 2012:76). The passage of time, high levels of performance, and the fulfilment of promises also promote trust. Different types of organisational levels of trust have been examined in the literature (Gust & Fedorowicz 2008:408). These include expertise, calculative, competence, integrated trust, trust in integrity, trust in predictability, trust in credibility, trust in goodwill, deterrence-based, knowledge based and contractual trust (Gust & Fedorowicz 2008:408). However, Fawcett et al (2007:359) noted that these different types of trust can be grouped into three categories. **Institution-based trust** is trust generated by confidence in the "formal structures" of society and more importantly in their ability to impose sanctions when trust is breached. **Meso-level characteristic-based trust** is trust based on the characteristics or reputation of the transacting parties. **Process-based trust** is trust that is derived from experience of cooperative interaction. This form of "inter-firm trust is built incrementally as firms repeatedly interact" (Fawcett et al 2007:359). Burt et al (2010:82) asserts that with institutional trust, the parties have access to each other's strategic plans in the areas of interface between the companies and their respective cross-functional teams. With this trust, the relationship can be measured and managed. Figure 2.7 illustrates the supply chain relationship spectrum and institutional trust.

Figure 2.7: The supply chain relationship spectrum and institutional trust



Source: Burt et al (2010:82)

Traditional organisations that memorialise their supply chain agreements with detailed legal contracts often overlook the value of trust (Burt et al 2010:82). According to Burt et al (2010:70), strategic alliances have *institutional trust*. With *institutional trust*, the parties have access to each other's strategic plans in the area(s) of the interface (measured and managed). Relevant cost information and forecasts are shared. Risks and rewards are addressed openly. Informal agreements are as good as written ones (Burt et al 2010:70 & 82). According to Fawcett et al (2007: 358), trust is guided by certain principles which include the following: the fact that trust is two sided and trust is behaviour. Trust requires open information sharing, trust is personal and trust means performance. To build trust, supply chain managers should keep in mind the principles of trust (Fawcett et al 2007: 358). Table 2.2 depicts a two-world view of supply chain trust.

Table 2.2: Sample two-world view of supply chain trust

Description	Buyer organisation	Supplier organisation
Power	Have it	Do not have it
Corporate objectives	Reduces costs	Protects margins
Relationship expectation	Have needs met buying solutions	Be treated fairly
Communication style	The facts	Seek to accommodate
Problem solving	Do not like to be corrected by suppliers	Views offers of help that occur only after problems arise as intrusive/controlling
Definition of win-win	Suppliers should be happy if they are a little better off than before	Expected to be compensated for value-added over the life of relationships

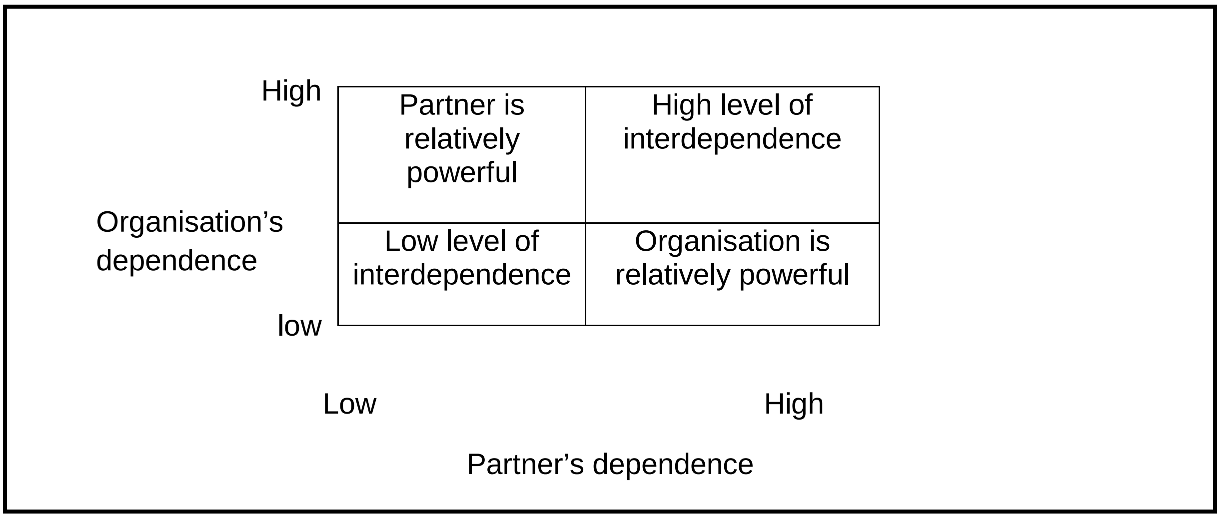
Source: Adapted from Fawcett et al (2007:358)

The different parties in a relationship often pull in different directions. As shown in table 2.2, a two-sided view of trust suggests that when the buyer says, "We need to squeeze costs out of the process," the supplier is likely to hear, "They plan to squeeze the margin out of us." Trust is hard to build when the power relationship is asymmetrical. Trustworthy behaviour tells supply chain partners they are valued. The easiest way to evaluate whether trust exists is to ask companies how their partners achieve their goals. If leverage is identified as the tool of choice, then trust is certain to be missing in the relationship (Fawcett et al 2007:358).

2.4.4 Power in supply chain relationships

In developing supply chain relationships, organisations thus strive towards a greater interdependence of operations without compromising independent ownership (Taylor 2004:66). Both the buyer’s and supplier’s investments are high and they become mutually dependent on each other (Hines 2006). In fact, in strategic alliances, total interdependence is required. Total interdependence refers to the intensity of the relationship. A high level of interdependence is an indicator for a strong cooperative long-term relationship in which both parties have invested. Mutual trust and mutual commitment will characterise those relationships (Caniëls & Gelderman 2005:44). The products involved in these partnerships are critical to success for both buyers and suppliers. Few critical suppliers are capable of supplying the product (Handfield et al 2009:212) because they may be unique or customised, or they may simply represent a high-value product. Because of the small number of suppliers it may furthermore be difficult and costly to switch between suppliers (Van Weele 2010:196). A balanced relationship between buyer and seller is thus required, in which neither of the two parties dominates the other (Van Weele 2010:197) and power is therefore shared (Caniëls & Gelderman 2005:44). This is illustrated in the top right quadrant in figure 2.8.

Figure 2.8: Balance of power in buyer-supplier relationships



Source: Adapted from Fernie (2009:40)

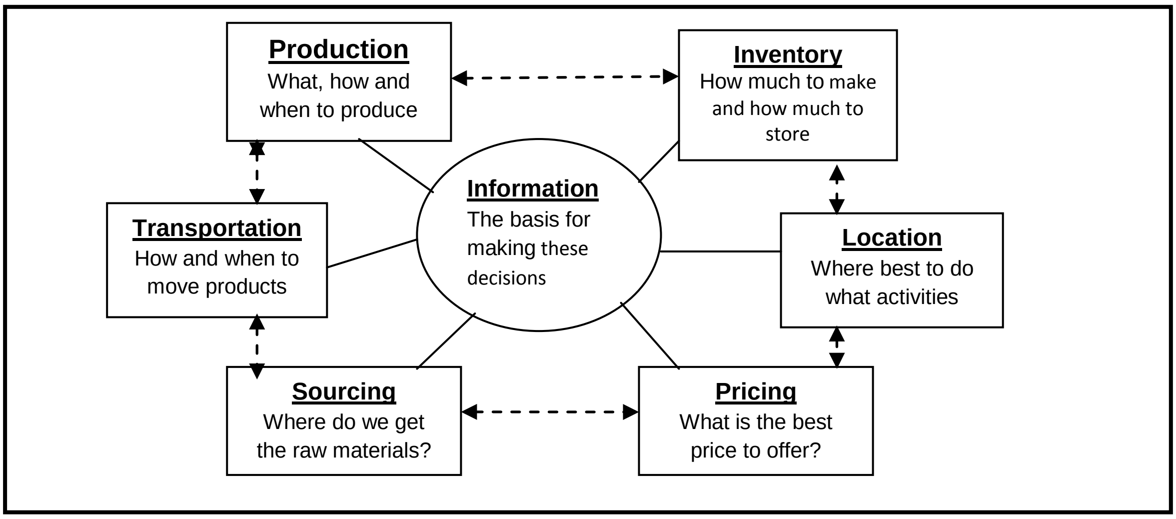
2.5 DECISION AREAS IN SUPPLY CHAIN MANAGEMENT

Sequences of events and flows that occur within and between the stages of a supply chain are aimed at fulfilling customers need for a product (Chopra & Meindl 2013:23). Supply chain decisions are complex and impact significantly on the firm's profitability as well as competitive position (Hugo et al 2004:85). Numerous and large bodies of data that form part of the supply chain activities further complicate decision processes in the supply chain. Bowersox, Closs and Cooper (2010:343) assert that key decision areas in the supply chain include selecting the number and location of plants, warehouses and other supply chain nodes. It is therefore essential to understand the areas in which important decisions should be made.

2.5.1 Supply chain key decision drivers

Decisions regarding design, planning and operations in a supply chain are made individually and collectively in an organisation (Hugo et al 2004:86). These decisions are classified into two broad categories, namely strategic and operational decisions. Strategic decisions are made over a longer time period. These decisions are closely linked to the corporate strategy and guide supply chain policies from a design perspective, while operational decisions are short term, and focus on activities on a day-to-day basis (Hugos 2006:5). SCM consists of a tactical and strategic decision-making process. Such decisions are characterised by medium- to long-term effects, medium to high levels of risk and uncertainty and relatively large consequences for the organisation involved. Hugos (2006:17) and Chopra and Meindl (2013:53) classify decision areas into production, transportation, inventory, location and information. These classifications are related in one way or the other. The overall decisions made concerning each driver will determine how well the supply chain serves its market, and how profitable it is for the participants in the supply chain. Figure 2.9 shows the structure of the five decision drivers of SCM.

Figure 2.9: Key decision drivers of SCM



Source: Hugos (2011:6); Chopra & Meindl (2013:53)

These decision drivers are discussed below.

2.5.1.1 Location decisions

Location decisions concern the geographic placement of production facilities, stocking points and sourcing, and are the natural first step in creating a supply chain (Chopra & Meindl 2013:54). An important element in designing a company's supply chain is the location of its facilities (Jacobs et al 2009:387). The location of facilities involves a commitment of resources to a long-term plan. Once the size, number and location are determined, so are the possible paths by which the product flows through the supply chain to the final customer. Location decisions are of great significance to a firm since they represent the basic strategy for accessing customer markets, and will have a considerable impact on revenue, cost and level of service. They are thus critical to a company's eventual success (Hugos 2011:6; Jacobs et al 2009:387).

2.5.1.2 Production decisions

These decisions are strategic and include what type of product to produce and which plants to produce them in, allocation of suppliers to plants, plants to distribution centres (DCs), and DCs to customer markets (Hugos 2011:5). This activity includes the creation of master production schedules that take into account plant capabilities, workload balancing, quality control and equipment maintenance (Chopra & Meindl 2013:53). A key decision in the production process is the management of its facilities. Even though there are many different types of facilities (Vogt 2009:305), facilities generally fall into one of two categories, depending on their primary function. The categories are production facilities (eg factories) and storage facilities (eg warehouses and distribution centres) (Taylor 2004:21). Facilities are the actual physical locations in the supply chain network where the product is stored, assembled or fabricated. Decisions regarding the role, location, capacity and flexibility of facilities have a significant impact on the supply chain's performance (Hugos 2011:5; Chopra & Meindl, 2013:54). It is clear from the decisions (location decision, sec 2.5.1.1) and this section (production decision) that there is an overlap in factors (variables) involved. Decision making can therefore not be made in isolation, but holistically, taking the total implementation into account.

2.5.1.3 Inventory decisions

Inventory exists at every stage of the supply chain (Hugos 2011: 5). It can be classified according to its position in the supply chain or based on its purpose (Cronje 2009:216).

When classified according to its position in the supply chain, inventory encompasses all raw materials, work-in-progress, packaging and finished goods within a supply chain (Chopra & Meindl, 2010:53; Hugos 2011:5). As noted by Hugo et al (2004:135) and Bowersox et al 2010:156), inventory decisions have a high impact throughout the supply chain, focusing on providing the right quantity at the right time without compromising the financial position of the firm (cost of inventory) or customer service level. The primary purpose in this decision is to buffer against any uncertainty that might exist in the supply chain (Mangan et al 2012:191). Inventory is strategic in the sense that top management set goals. Inventory decisions from an operational perspective include deployment strategies (push versus pull), control policies, the determination of the optimal levels of order quantities and reorder points and setting safety stock levels, at each stocking location. Safety stock levels are critical, since they are primary determinants of customer service levels. Holding large amounts of inventory in a supply chain increases cost, thereby making the supply chain less efficient (Chopra & Meindl 2013:53).

2.5.1.4 Transportation decisions

Transportation decisions involve how inventory should be moved from one supply chain location to another and moves the product between different stages in the supply chain (Chopra & Meindl 2013:53). This activity is closely linked to inventory decisions, since the best choice of mode is often found by trading-off the cost of using the particular mode of transport with the indirect cost of inventory associated with that mode. While air shipments may be fast, reliable and warrant lesser safety stocks, they are expensive. Meanwhile shipping by sea or rail may be much cheaper, but these modes necessitate holding relatively large amounts of inventory to buffer against the inherent uncertainty associated with them (Hugos 2011:6). Therefore customer service levels and geographic location (location decisions, sec 2.5.1.1) play a vital role in such decisions.

2.5.1.5 Information decisions

Information is one of the potential drivers of performance in a supply chain (Chopra & Meindl 2013:54), for it directly affects other decision areas and stages in the supply chain. This decision involves how much data should be collected and how much information should be shared. Timely and accurate information holds the promise of better coordination and better decision making. With reliable information, people can make effective decisions about what to produce and how much, about where to locate inventory and how best to transport the product (Hugos 2011:6). Information deeply affects every part of the supply chain. It helps companies to be more efficient and responsive (Hugos 2011:6). Information technology has become vital to supply chain performance (Christopher 2005:180). It is potentially the biggest driver of performance in the supply chain (Bozarth & Handfield 2006:339). This is because it directly affects each of the other drivers (Chopra & Meindl 2013:54). Many successful organisations (or supply chains) use information to improve customer responsiveness (Christopher 2005:181).

2.5.1.6 Sourcing decisions

Sourcing decisions are often strategic decisions and are important because they determine the capacity and resource requirements of supply chain members (Bozarth & Handfield 2006:297). Sourcing involves the choice of who will perform (third party) a particular supply chain activity, such as production, storage, transportation or the management of information (Mangan et al 2012:170). At the strategic level, these decisions determine what functions an organisation performs and what functions the organisation outsources to other organisations (Chopra & Meindl 2013:54). Organisations therefore have to decide whether they need to outsource certain activities to other supply chain members or whether they should insource the activities. A distinction can be made between insourcing and outsourcing. Inurcing takes place when resources in the organisation are used to produce products or render services and outsourcing uses external supply chain members to provide products or services. Insourcing provides an organisation with control over its operations and encourages the development of core competencies (Bozarth & Handfield 2006:297 & 298), while outsourcing provides advantages such as making use of the specialised knowledge and capabilities of suppliers (Burt et al 2010:230). Once potential suppliers have been identified they have to be evaluated. According to Swink, Melnk, Cooper and Hartley (2011:290), organisations have to assess the supplier’s fit with the organisation’s core competencies.

2.5.1.7 Pricing decisions

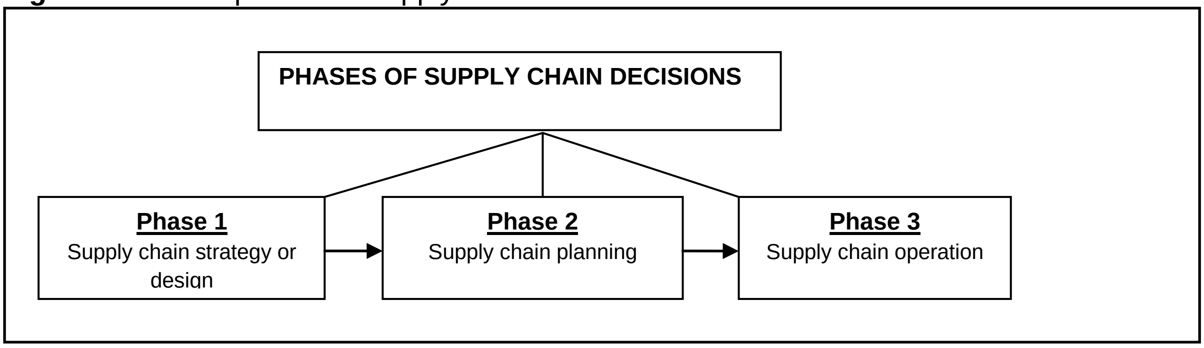
Pricing determines how much an organisation will charge for products that it makes available in the supply chain (Chopra and Meindl, 2013:54). Demand usually (but not always) will go up as a product’s price goes down. Organisations must also know how sensitive customers are to price changes. Organisations thus have to determine the optimal price for their products. To find the optimal price for a product, organisations have to be able to characterise the relationship between pricing and demand for each product that is sold

(Simchi-Levi *et al*., 2008:389). Pricing affects the behaviour of the buyer of the product, thus affecting supply chain performance.

2.5.2 Phases in supply chain decisions

Supply chains have leapt from the backroom to the boardroom so quickly that most companies are just beginning to formulate designs for their supply chains (Taylor 2004:279). Successful SCM requires many decisions relating to the flow of information, product and funds. These decisions fall into three categories or phases, depending on the frequency of each decision and the time frame over which a decision phase has an impact (Chopra & Meindl 2013:18). The phases of supply chain design (SCD) decisions can be depicted as shown in figure 2.10. They are SCD decisions, planning and operational decisions. The phases or classification of decisions stretches over different time spans, with SCD decisions over longer periods, planning over shorter and operational decision over the shortest time span. Figure 2.10 represents the phases of supply chain decisions.

Figure 2.10: The phases of supply chain decisions



Sources: Adapted from Chopra & Meindl (2013:18)

2.5.2.1 Decisions on supply chain design or strategy

According to Fawcett et al (2007:227), historically, supply chains have evolved (and were not designed), responding to changes in the business environment. SCD involves planning and developing supply chains to support the value proposition and goals of an organisation. Supply chain design is a proactive approach to serving customers. It generally involves all the stages from idea generation to prototype development (Pan & Holland, 2006:346). In designing a supply chain, decisions need to be made about the number and location of production facilities, the amount of capacity at each facility, the assignment of each market region to one or more locations and supplier selection, subassemblies, components and materials (Meixell & Gargeya 2005:532). As a unit composed of various parties with overlapping and conflicting interests, supply chains are composed and subsequently decomposed or restructured depending on the specific needs or emerging circumstances in the business environment (Ismail & Sharifi 2006:436).

SCD is a critical factor in determining the efficiency and effectiveness of a supply chain (Khan, Christopher & Burnes 2008:416). A key issue in designing a firm's supply chain is effective integration of all processes. However, supply chain design practices have been concentrated mostly in the manufacturing functions (Borade & Nansod 2007:112; Sezen 2008:234). The challenges of designing a supply chain are to determine the structure of the supply chain as a whole (SC organisation), roles and responsibilities and finding the right people with the right skills. Supply chain organisation evolves constantly, depending on changed business requirements or identified improvement initiatives. The roles and responsibilities might change, as well as goals and priorities (Chopra & Meindl 2013:18).

2.5.2.2 Supply chain planning decisions

Supply chain planning is concerned with the coordination and integration of key business activities undertaken by an enterprise, from the procurement of raw materials to the distribution of the product to the customer (Nagar & Fain 2008:251). Supply chain planning includes the set of activities that focus on evaluating demand for material, capacity, and formulation of plans and schedules based on meeting the demand and company goals. According to Kaipia and Holmstrom (2007:3), in planning a supply chain, the company collects relevant information about the market, downstream inventory and combines this information with the supply capabilities and constraints. The goal is to plan how the supply networks are to respond to future demand. The planning process in the supply chain also consists of forecasting sales, demand planning and matching demand information and supply capabilities (Kaipia & Homstrom 2007:3; Bowersox et al 2010:133). In addition, planning includes decisions about which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies to be followed and the timing and size of marketing promotions.

As noted by Chopra and Meindl, (2013:19), planning establishes parameters within which a supply chain will function over a specified period of time. In the planning phase, companies must take cognisance of uncertainty in demand, exchange rates and competition over this time horizon in their decisions. With planning, companies define a set of operating policies that govern short-term operations. Planning may take place on strategic, tactical and operational levels, which differ by time horizon, planning frequency and scope (Emmett & Crocker 2006:56; Kaipia, 2007:17). Strategic or long-term planning models aim to identify optimal timing, location and the extent of investment in supply or distribution networks. Strategic planning involves resource decisions over the long term. Mid-term or tactical planning models address planning horizons of one to two years (Kaipia 2007:17). The following three factors drive effective planning: (1) supply chain visibility; (2) simultaneous resource consideration; and (3) resource utilisation (Bowersox et al 2010:133).

2.5.2.3 Supply chain operation decisions

Supply chain operations refer to short-term decision making by supply chain managers who execute the activities of the supply chain (Shapiro 2007:539). Managing supply chain operations is critical to any company's ability to compete effectively (Sadler and Gough, 2005:892; Chopra and Meindl, 2013:19). The supply chain has traditionally been managed as a series of simple, compartmentalised business functions. It was driven by manufacturers who managed and controlled the pace at which products were developed, manufactured and distributed. In recent years, however, customers have forced increasing demands on manufacturers for options/styles/features, quick order fulfilment and fast delivery. Operations planning should identify policies which will achieve customer criteria for sustained order placement. Operations processes in the supply chain need to link with strategies, be consistent with corporate and marketing strategies of supply chain partners and be operated by a time phased series of actions (Sadler and Gough, 2005:892).

In the operations of a supply chain, the time horizon should be weekly or daily. During this phase, companies make decisions regarding individual customer orders. Supply chain configuration on the supply chain operational level, is considered fixed and planning policies are already defined. The goal of supply chain operations is to handle incoming customer orders in the best possible manner (Chopra and Meindl, 2013:19). During this phase, firms allocate inventory or production to individual orders, set a date an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery schedules of trucks, and place replenishment orders. Because operational decisions are being made in the short term (minutes, hours, or days), there is less uncertainty about demand information. Given the constraints established by the configuration and planning policies, the goal during the operation phase is to exploit the reduction of uncertainty and optimise performance (Chopra and Meindl, 2013:19).

2.6 SUPPLY CHAIN PROCESSES

SCM is being recognised as the integration of key business processes across the supply chain. The implementation of SCM involves identifying the supply chain members with whom it is critical to link, the processes to be linked with each of these key members, and the type/level of integration that applies to each process link (Lambert 2006:5). Stavrulaki and Davis (2010:127) assert that SCM processes that cross organisational boundaries can be easily defined, analysed and improved to provide companies with a sustainable competitive advantage. According to Stavrulaki and Davis (2010:133), supply chain processes are defined as the set of activities used to carry out the movement of material through the supply chain network.

2.6.1 Types of supply chain management process

Two of the most developed and influential process frameworks in SCM are the Global Supply Chain Forum's (GSCF) model and the Supply Chain Operations Reference (SCOR) model (Lambert 2006:217-218; Stavrulaki & Davis, 2010:131; Kuik, Nagalingam & Amer 2011:988). These two frameworks represent the alternatives available with sufficient detail to assist the management of organisations in the implementation of business processes (Lambert 2006:217–218). These frameworks are process based and each one takes a distinctly different approach to SCM. In the current research, a process in the supply chain is concerned with a series of activities from original suppliers and manufacturers to retailers to add value for the end customer (Chan & Qi 2003:182). Nevertheless, these frameworks are diverse in terms of their centric focus, supply chain strategy, scope of organisational activities, value creation in a supply chain and collaboration in a global partnership (Kuik et al 2011:988).

2.6.1.1 The Global Supply Chain Forum (GSCF) supply chain processes

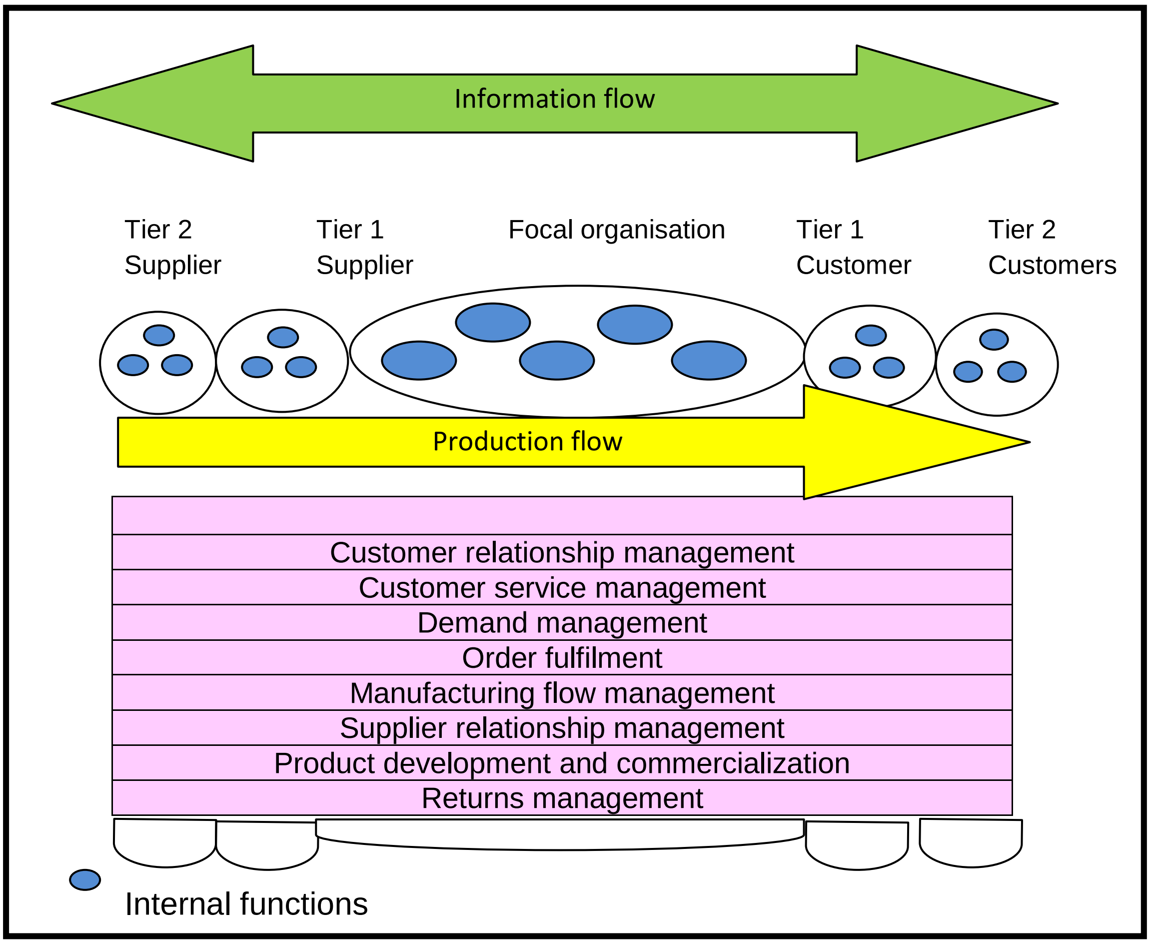
The model proposed by the GSCF consists of the following three elements: the supply chain network structure, supply chain management components, and supply chain management processes (Mortensen & Lemoine 2008:335). The supply chain network structure encompasses the key supply chain members that are vital to a supply chain that creates value for customers. Examples of such key members are original suppliers, intermediaries, TPL providers, customers and customers' customers (Mortensen & Lemoine 2008:335).

The supply chain management components of the model refer to the components supporting the cooperation between the participants in the supply chain and the integration processes. Management components are divided into the following two groups: the physical and technical management components, such as planning and control methods, and the managerial and behavioural components, such as management methods, culture and attitudes (Mortensen & Lemoine 2008:335). The supply chain management processes of the GSCF model comprise the following eight key business processes:

- customer relationship management
- customer service management
- demand management
- order fulfilment
- manufacturing flow management
- procurement of supplier relationship management
- product development and commercialisation
- returns management

Figure 2.11 illustrates a framework for the GSCF supply chain processes.

Figure 2.11: The eight supply chain management processes



Source: Adapted from Lambert (2006:3)

While management of all firms in each supply chain should consider these eight processes, the relative importance of each process and the specific activities included may vary. A brief description of the processes is now discussed.

- **Customer relationship management.** Customer relationship management involves identifying key customers and segment customer groups on the basis of their value over time to increase customer loyalty by providing customised products (Wisner et al 2012:472). According to Lambert (2006:13), over time, relationships with key customers are solidified through the sharing of information; the formation of cross-organisational teams to improve products, deliveries, quality and costs; the development of shared goals; and finally, improved performance and profitability for the trading partners along with agreements on how to share these benefits (Wisner et al 2012:472). Customer relationship management provides a structure and strategy for a relationship with customers (Lysons & Farrington 2006:96).

- **Customer service management.** Customer service management provides the customer with real-time information on promised shipping dates and product availability through interfaces with functions such as manufacturing and logistics (Wisner et al 2012:472). It includes the methods for monitoring and reporting customer service performance to allow organisations to understand to what extent their management efforts are achieving the process objectives (Lambert 2006:13–14). It provides the single source of customer information, such as product availability, shipping dates and order status. Customer service management provides internal and external customers with high-quality products at the lowest possible cost, with the shortest waiting times and maximum responsiveness and flexibility regarding their needs (Lysons & Farrington 2006:96).

- **Demand management.** Demand management is the SCM process that balances the requirements of internal and external customers with the capabilities of the supply chain (Lysons & Farrington, 2006:96). With the right process in place, management can proactively match supply with demand and execute the plan with minimal disruptions. Wisner et al (2012:473) assert that demand management process is not limited to forecasting, but also includes synchronising supply and demand, increasing flexibility and reducing the variability of demand (Lambert 2006:14). Performance measurement systems can prove quite useful for increasing the accuracy of forecasts and for tracking the success of implementing various demand management activities (Wisner et al 2012:473).

- **Order fulfilment.** A key to effective supply chain management is to meet customer requirements in terms of order fulfilment. According to Wisner et al (2012:474), order fulfilment processes involve all the activities necessary to define customer requirements, design a network and enable an organisation to meet customer requests while minimising the total delivered cost, as well as filling customer orders. The objective is to develop a seamless process from the supplier to the organisation and its various customer segments (Lambert 2006:14). Customers' orders thus need to be fulfilled efficiently, effectively and at the minimum total cost (Lysons & Farrington 2006:97). The order fulfilment process is therefore a set of activities that allows the organisation to fill customer orders while providing the required levels of customer service at the lowest possible delivered cost.

- **Manufacturing flow management.** The manufacturing flow management process is the set of activities responsible for making the actual product (Wisner et al 2012:474). According to Lambert (2006:14), it is the SCM process that includes all activities necessary to move products through the plants and to obtain, implement and manage manufacturing flexibility in the supply chain. To be effective, manufacturing flow management activities must be interfaced with the demand management and CRM processes, using customer requirements as inputs to the process. Hence manufacturing flow management is concerned with all the processes and activities required to transform inputs and a variety of resources into finished products (Lysons & Farrington 2006:97).

- **Supplier relationship management.** Supplier relationship management is the process that defines how a company interacts with its suppliers (Wisner et al 2012:474). Relationships may be either short or long term and vary in intensity from arms-length to high involvement (Lysons & Farrington 2006:97). An organisation will forge close long-term relationships with a small subset of its suppliers with a desired outcome of win-win relationships, while managing arms-length relationships with others (Lambert 2006:14). Supplier relationship management is becoming increasingly critical as organisations concentrate on core competencies and rely on suppliers to maintain critical advantage or a superior position over competitors (Lysons & Farrington 2006:97).

- **Product development and commercialisation.** Product development and commercialisation are the SCM process that provides structure for developing and bringing new products to meet changing customer requirements (Wisner et al 2009:452). The process typically consists of four phases, namely (1) idea generation, (2) concept development, (3) product and process design and (4) production and delivery. SCM is involved because product development extends across internal and external boundaries. Internally, product development involves teamwork between marketing, design, purchasing, production, quality engineering and transportation (Lambert 2006:14, 15). Externally, the uncertainties of supply and demand, shorter life cycles, faster rates of technological change and the increased use of manufacturing, distribution and logistics partners has resulted in increasingly complicated supply chain networks (Lysons & Farrington 2006:97).

- **Returns management.** Returns management is the SCM process by which activities associated with returns, reverse logistics, gate keeping and avoidance are managed within the organisation and across key members of the supply chain. Effective returns management is a vital part of SCM and provides an opportunity to achieve a sustainable competitive advantage (Lambert 2006:15). It extends relationships beyond customers and suppliers to include cooperation with agencies such as local authority and private waste collection, recycling and disposal (Lysons & Farrington 2006:97) and therefore includes environmental compliance. Returns management personnel frequently communicate with customers and personnel from CRM, product development and commercialisation and SRM during the returns process (Wisner et al 2009:452).

2.6.1.2 The SCOR model

One of the most recognised methods for integrating supply chain and measuring trading partners' performance is the use of the Supply Chain Operation Reference (SCOR) model (Wisner et al 2012:518). This model was developed by the Supply-Chain Council (SCC) to assist firms in increasing the effectiveness of their supply chains and to provide a process-based approach to SCM (Lockamy III & Mccormack 2004:1192; Swink et al 2011:42; Webster 2008:352; Petterson 2008:30). According to Gulledge and Chavusholu (2008:754), the SCOR model has been revised a number of times to shape the contribution for SCM improvements (Wisner et al 2012:518).

Pettersen (2008:31) states that the purpose for developing a SCOR model was to

- provide a standard language for SCM that can be used cross-industry
- facilitate external benchmarking
- establish a basis for analysing supply chains
- compare the current supply chain with the target for the future

The SCOR model is used as a SCM diagnostic, benchmarking and process improvement tool by manufacturing and service firms in a variety of industries around the globe (Wisner et al 2012:518). The SCOR model separates supply chain operations into five process categories which include plan, source, make, deliver and return (Lockamy III & Mccormack 2004:1192; Lambert 2006:219; Petterson 2008:31; Webster 2008:353). These categories can be explained as follows.

- **Plan.** Plan balances aggregate demand and supply to develop a course of action which best meets sourcing, production and delivery requirements (Lambert *et al.*, 2006:220). Plan therefore refers to all the operations needed to plan and organise the operations in the other categories (Hugos 2011:40). Plan*,* as a process in this model, includes balancing resources with requirements (demand forecasting), establishing and communicating plans for SCM of business rules, supply chain performance, data collection, inventory, capital assets, transportation, product pricing and regulatory requirements (Wisner et al 2009:495 & 496; Hugos 2011:40).

- **Source.** Source includes activities related to procuring products to meet planned and actual demand (Lambert 2006:220). Source thus includes the activities necessary to acquire the inputs to create products. An example of a process here is procurement, which is the acquisition of materials and services (Hugos 2011:40).

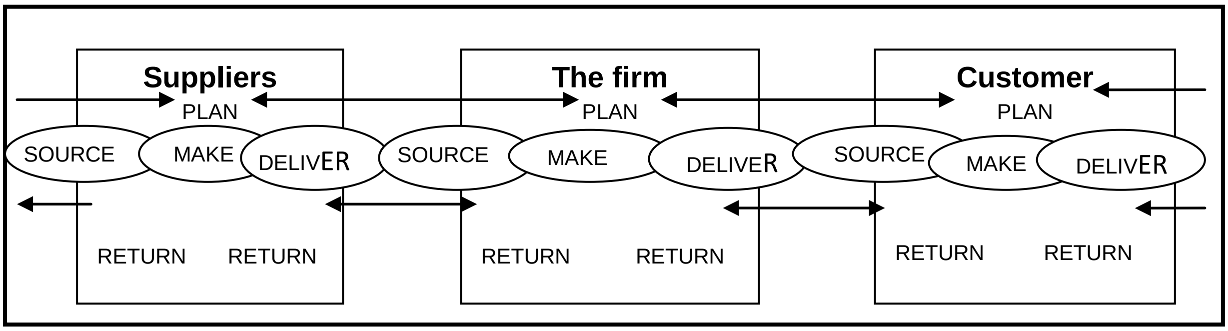
- **Make.** Make includes activities related to transforming products into a finished state to meet planned or actual demand (Lambert 2006:220). It includes the operations required to develop and build the products that a supply chain provides. Although the SCOR model does not specifically mention the product design and development process, one can accept that it is part of the make element because it is integral to the production process. Other examples include production management and facility management (Hugos 2011:41).

- **Deliver*.*** Deliver involves providing finished products to meet planned or actual demand, typically including order management, transportation management, and distribution management (Lambert 2006:220). These operations encompass the activities that are part of receiving customer orders and delivering products to customers (Hugos 2011:42).

- **Return*.*** Return deals with returning or receiving returned products for any reason and extends into post-delivery customer support (Lambert 2006:220).

Lambert (2006:219) notes that the SCOR model has three components which include business process re-engineering, benchmarking and best practice analysis. The use of the business process re-engineering technique captures the current state of a process and determines the "to be" state. Benchmarking is used to determine target values for operational performance while best practice analysis identifies management practices and software solutions used successfully by similar companies that are considered top performers (Lambert 2006:220; Gulledge & Chavusholu 2008:756). Figure 2.12 below indicates a framework for the SCOR model.

Figure 2.12: The SCOR model linkages



Source: Adapted from Lockamy III & Mccormack (2004:1194); Wisner et al (2008:495)

Each of the processes in this model is implemented in four levels of detail. Level 1 defines the number of supply chains as well as the metrics that will be used. Level 2 defines the planning and execution processes in material flow. Level 3 defines the inputs, outputs and flow of each transactional element. At level 4, the implementation details of the processes are defined (Lambert 2006:220). Table 2.3 represents the essential characteristics of the supply chain framework.

Table 2.3: Essential characteristics of the supply chain framework

Characteristic	SCOR	GSCF
Centric focus	Achieve transactional and operational improvement	Achieve corporate long-term improvement
Supply chain strategy	More focused on the operational strategy based on benchmarking analysis for developing the organisational goals	Aligned corporate and functional strategies to develop organisational activities
Value creation	Align with operational strategy if low intra-operational efficiency	Align with corporate strategy if high intra-organisational efficiency
Scope of organisational activities	More focused on customer-oriented approach by considering the interaction of customer's order and demand fulfilment only	Cross-functional integration of business processes that describe every business activity
Sustainability	A strong linkage between various emissions and the originating processes	The development of avoidance, gate-keeping and disposition guidelines for improving returns management
Collaborative in a global partnership	Emphasis on intra-organisational activities within logistics, production and purchasing functional units for mutual agreement of decision synchronisation	Emphasis on customer and supplier relationship for mutual agreement of decision synchronisation and streamlined intercompany business processes

Source: Kuik et al (2011:989)

2.7 CHAPTER SUMMARY

This chapter presented the theoretical framework of supply chain management. It focused on the definition of and background to supply chain management, supply chain integration practices, relationships in the supply chain, supply chain decision areas and processes in the supply chain. The overall objectives of SCM are to create value for customers, provide a competitive advantage and improved profitability for supply chain firms, determine the dimensions of value that may be important to customers and the develop mechanisms whereby competitive advantage and improved profitability can be achieved. The next chapter focuses on SCM practices in the automotive industry.

CHAPTER 3

SUPPLY CHAIN MANAGEMENT PRACTICES IN THE AUTOMOTIVE INDUSTRY

3.1 INTRODUCTION

Chapter 2 dwelt on the theoretical framework of SCM. In chapter 3, SCM practices in the automotive industry will be presented. The chapter presents an overview of the global automotive industry and depicts the state of the South African automotive industry as well as SCI practices. It also discusses optimal supply chain practices in the automotive industry, reviews supply chain challenges in the South African context and identifies important key performance indicators for optimising supply chain performance.

3.2 THE STATE OF THE GLOBAL AUTOMOTIVE INDUSTRY

This section of the chapter discusses the background to the global automotive industry, early developments in the industry and its importance in the global economy.

3.2.1 Background to the global automotive industry

The automotive industry is one of the most global of all industries with its products spread around the world. It is dominated by small companies with worldwide recognition (Humphrey & Memedovic 2003:2; Barnes & Morris 2008:32; Lamprecht 2009:130). It represents the largest manufacturing sector in the world, with output of the industry equivalent to the world's sixth largest economy (OICA 2008). The industry is characterised by global mergers and relocation centres in emerging economies (Nag et al 2007:1). While the industry is a key activity in advanced industrial nations, it is also of increasing significance in emerging economies of North and East Asia, South America and Eastern Europe (Nag et al 2007:1). It draws on a wide range of supplier industries, from raw materials (such as steel, aluminium, plastics and chemicals) through to sophisticated component assemblies, tooling, design and engineering services. The industry is also one of the largest investors in research and development (R&D), playing a key role in society-wide technological development (Charles 2009). With its skill base and innovative practices, the automotive sector is often seen as providing an effective national training ground for many manufacturing and engineering employees in extremely diverse industries (Commonwealth of Australia 2008). The global automotive industry is currently led by the main manufacturers (OEMs), that is, Toyota, General Motors, Volkswagen, Ford, Honda, PSA, Nissan, BMW and Chrysler, which function in an international, competitive market (Naude 2009:33).

According to Ciferri and Revill (2008:1), the economic crisis in 2008 triggered a huge decline in the number of global original equipment manufacturers (OEMs), leading to consolidation in 2010. General Motors dominated the global ranking for 77 years up to 2007. The top ten OEMs accounted for 68.9% of total global vehicle production representing in the order of 47,9 million units in 2008. According to OICA (2008), Toyota increased its production by 55,1% or nearly 3,3 million units between 2000 and 2008. General Motor's production increased by only 0,2%, Volkswagen's production increased by 26,1%, while Ford's production declined by 26,2% over the same period. Table 3.1 shows the world ranking of the top ten OEMs in 2008.

Table 3.1: World ranking of motor vehicle manufacturers, 2008

Rank	Group	Total	Cars	LCV	HCV	Heavy Bus
1	TOYOTA	9,237,780	7,768,633	1,102,502	251,768	114,877
2	GM	8,282,803	6,015,257	2,229,833	24,842	12,871
3	VOLKSWAGEN	6,437,414	6,110,115	271,273	46,186	9,840
4	FORD	5,407,000	3,346,561	1,991,724	68,715	-
5	HONDA	3,912,700	3,878,940	33,760	-	-
6	NISSAN	3,395,065	2,788,632	463,984	134,033	8,416
7	PSA	3,325,407	2,840,884	484,523	-	-
8	HYUNDAI	2,777,137	2,435,471	85,133	151,759	104,774
9	SUZUKI	2,623,567	2,306,435	317,132	-	-
10	FIAT	2,524.325	1.849.200	516.164	135.658	23.303

Source: OICA (2010)

In the last ten years there have been major changes in the automotive industry. These changes stem from new technologies and the rise of more fuel-efficient and eco-friendly vehicles taking over the marketplace. Also, there were major changes in the world automotive industry regarding leadership. In 2000, the USA led the world in production with 12 799 857 units produced, followed by Japan with 10 140 796. By 2005, the USA was in a steady decline while other markets rose sharply. The most notable was China, whose automobile production doubled by 2005 to 5 708 421 units (Commonwealth of Australia 2008:14). In 2007, worldwide production reached a peak at a total of 73,3 million new motor vehicles produced worldwide (OICA 2008; Commonwealth of Australia 2008:14). As early as 2008, Japan had taken over the number one spot with 11 563 629 units produced, followed closely by China at 9 345 101. At this time, the USA had a large decrease in market share with only 8 705 239 units produced.

In 2009, there was a worldwide automobile crisis, which hit North America hard when the Big Three, General Motors, Ford and Chrysler, almost went into bankruptcy. Every country saw a significant decline in its automobile production and although the top five countries, Japan, China, South Korea, Germany, and the USA, maintained the top five positions, there were some major changes. China became the world's largest motor vehicle market, both by sales and by production. Sales in China rose 45% to maintain the top position in 2009 with 13,6 million units, in 2010 18,2 million units were sold and by 2011 sales were 18,4 million units (OICA 2012). Table 3.2 shows the top 20 leading automotive nations as of 2009 as well as their production status in the years 2000 to 2011.

Table 3.2: Top 20 leading automotive nations as of 2011

Rank	Country	2011	2010	2009	2005	2000
01	China	18,418,876	18,264,66	13,790,99	5,708,421	2,069,069
02	United States	8,653,560	7,761,443	7,934,516	11,946,65	12,799,857
03	Japan	8,398,654	9,625,940	5,711,823	10,799,65 9	10,140,796
04	Germany	6,311,318	5,905,985	5,209,853	5,757,710	5,526,615
05	South Korea	4,657,094	4,271,941	3,512,916	3,699,350	3,114,998
06	India	3,936,448	3,536,783	3,182,617	1,638,674	801,360
07	Brazil	3,406,150	3,381,728	2,632,694	2,530,840	1,681,517
08	Mexico	2,680,037	2,345,124	2,170,078	1,624,238	1,935,527
09	Spain	2,353,682	2,387,900	2,049,762	2,752,500	3,032,874
10	France	2,294,889	2,227,742	1,557,290	3,549,008	3,348,361
11	Canada	2,134,893	2,071,026	1,489,651	2,688,363	2,961,636
12	Russia	1,988,036	1,403,244	1,090,139	1,351,199	1,202,589
13	Iran	1,648,505	1,599,454	974,569	817,200	141,546
14	United Kingdom	1,463,999	1,393,463	968,305	1,803,109	1,813,894
15	Thailand	1,457,798	1,644,513	879,186	1,122,712	325,888
16	Czech Republic	1,199,834	1,076,385	869,905	602,237	455,492
17	Turkey	1,189,131	1,094,557	843,239	879,452	430,947
18	Indonesia	837,948	702,508	752,310	500,710	379,300
19	Poland	837,132	869,376	722,431	613,200	504,972
20	Argentina	828,771	716,540	522,810	319,755	339,632

Source: OICA (2012)

3.2.2 Early developments in the global automotive industry

A century ago, the car industry invented industrial capitalism (Lamprecht 2009:130). The industry originated in Germany and its further early development started in France in the 1900s. The automobile started with the development of the engine which resulted from the discovery of new energy carrying mediums, such as steam (Bradley, Bruns, Fleming, Ling, Margolin & Roman 2005:1). In the 1890s and early 1900s, other technologies were developed, such as the steering wheel and floor-mounted accelerator. Famous vehicle models such as Ford's Model T were developed at this time and by 1906, car designs began abandoning the carriage look and taking on a more "motorage" appearance. The 1910s saw the development of new technologies and societal infrastructure continued to develop as well. The 1920s saw the development of infrastructure, such as roads, adoption of new manufacturing practices, and the merging of companies (Carson 2004:4). In the 1930s, several new vehicle brands were developed and trends in vehicle consumer preferences were established that differentiated the American and European markets (Bradley et al 2005:2).

In the 1940s, automotive factories were used to make military vehicles and weapons during the Second World War. After the war, the major economies were decimated. This resulted in the development of new production and business strategies. In the 1950s and 1960s, more technological innovations, such as fibreglass bodies and higher compression ratio fuels were introduced. Car designs were highly influenced by emerging safety and environmental regulations. Vehicle speed limits and front seat belts became standard (Bradley et al 2005:2). The 1970s were marked by stricter environmental regulations and the oil embargo of the early 1970s, which led to the development of low emission vehicle technologies. In the 1980s, higher quality, affordable, and fuel efficient cars from Japanese automakers were developed (Bradley et al 2005:2).

In the current decade, there is increasing sophistication and empowerment of the consumer which has led automakers to identify new and more specialised markets within saturated markets with diverse customer bases. Also, infiltration of new emerging markets has encouraged the establishment of production facilities overseas and the establishment of global alliances and commercial strategic partnerships with foreign automakers (Muthukumar 2007:2). This has led to the epitome of mass production, mass marketing and mass consumption (Carson 2004:3). As noted by Lamprecht (2009:131), modern factories have to reap the benefits of economies of scale in their production.

3.2.3 Importance of the global automobile industry

The automobile industry is a crucial industry in the world economy and is also one of the largest industrial sectors in the world. The European Commission (2006:9) views the automotive industry's contribution to an economy as follows: a major contributor to value added; a significant source of employment; a leading investor in innovative research and development (R&D); an investment-intensive industry; an important source of fiscal revenue; and a significant contributor to trade. According to Wei and Chen (2008:974), the industry is a symbol of technical advancement by humankind and one of the fastest growing sectors in the world.

According to Charles (2009), the automotive industry is one of the largest industrial sectors in the world. The sector contributes between 4 and 8% to GDP and accounts for 2 to 4% of the labour force in the Organization for Economic Co-operation and Development (OECD) countries (Afsharipour et al 2006:1). Afsharipour et al (2006:1) note that nearly 700 million motor vehicles were registered worldwide with over 550 million vehicles (75% of passenger cars) registered in OECD countries. The total turnover of auto manufacturing worldwide is around $2,6 trillion. As noted by Hill, Menk and Cooper (2010), in the USA, historically, the auto industry has contributed 3 to 3,5% to overall gross domestic product (GDP) and has on average directly employed over 1,7 million people engaged in designing, engineering, manufacturing and supplying parts and components to assemble, sell and service new motor vehicles. The auto industry spends $16 to $18 billion every year on research and product development, 99% of which is funded by the industry itself. Owing to the industry's consumption of products from many other manufacturing sectors, it is a major driver of the 11,5% manufacturing contribution to GDP. It is also a major innovator, investing over €84 billion in research, development and production. The auto industry plays a key role in the technology level of other industries and of society. Vehicle manufacturing and use are also major contributors to government revenues around the world, contributing well over €400 billion (OICA 2008).

Manufacturing vehicles requires the employment of about nine million people directly in producing the vehicles and the automotive components that go into them. This comprises over 5% of the world's total manufacturing employment. Many people are also employed in automotive-related manufacturing and services as the sector uses the goods of many industries including steel, iron, aluminium, glass, plastics, carpeting, textiles, computer chips and rubber. It is estimated that each direct automotive job supports at least another five indirect jobs, resulting in more than 50 million jobs globally owed to the automotive industry (NAAMSA 2012). In the world's biggest auto market, the USA employed more than 880,000 people in the motor manufacturing sector until the end of 2008 (Platzer & Harrison 2009:2). However, China overtook the USA to become the world's biggest auto market for the first time, with annual sales exceeding 13,64 million units in 2009. The largest companies General Motors, Chrysler, Ford Motors, Honda and Toyota Motors, also had the biggest workforces. The Asian auto giant Japan provided jobs for 725 000 people in the car manufacturing sector until 2008. The total Japanese automotive workforce managed to produce 11,5 million vehicles in 2007 (OECD 2011). As many as 725 000 people are employed in Russian auto manufacturing units.

While the industry is a key activity in advanced industrial nations, it is also of increasing significance in the emerging economies of North and East Asia, South America and Eastern Europe. It draws on a wide range of supplier industries, from raw materials (such as steel, aluminium, plastics and chemicals) through to sophisticated component assemblies, tooling, design and engineering services. Today, nearly 700 million motor vehicles are registered worldwide with over 550 million vehicles (75% passenger cars) registered in OECD countries. This industry leads all other industries in research and development (R&D) investments and its levels of productivity are well above average (Afsharipour et al 2007:1).

The automotive industry has tended to be the object of national aspirations in many countries. Governments, both national and regional, see the automotive industry as being a key industry, for example, the southern US states have been particularly active in attracting automotive investment over recent decades to build their regional economies. The reason for this is not just the size of the industry in terms of jobs, investment and trade, although these remain important politically, but also its value as a sign of industrial success, a beacon for attracting investment in other industries and a key element of broader innovation systems (Charles 2009).

3.3 REVIEW OF THE SOUTH AFRICAN AUTOMOBILE INDUSTRY

Section 3.3 presents a review of the South African automotive industry. The section discusses the state of the automotive sector in South Africa, origins of the South African automotive industry, the South African automotive industry policy, the motor industry development programme (MIDP), the automotive production and development programme (APDP), key role players as well as the characteristics of South Africa's automotive production.

3.3.1 The state of the automotive sector in South Africa

South Africa's automotive industry is a global, turbo-charged engine for the manufacture and export of vehicles and components. Flatters and Netshitomboni (2006:3) state that the industry was South Africa's most heavily protected industry prior to the trade liberalisation launch in the 1990s. The sector has attracted enormous government attention and a wide range of public support. The industry has managed to achieve operations among all role players and is now fully integrated into the global framework of parent companies and multinationals (Fernandes & Erasmus 2005:3). All of the major vehicle makers are represented in South Africa. Many of the major multinational companies use South Africa to source components and assemble vehicles for both the local and overseas markets. The major brands in South Africa include Toyota, Ford, GM, Mercedes-Benz and Volkswagen. Other brands that entered and re-entered include Alfa Romeo, Renault and Chevrolet, Mahindra, Sang, Yong, Dacia, Kia, Hyundai, Daewoo, Saab and Subaru, Bentley, Cadillac, Citroën, Dodge, Maybach, Mini, Proton, TVR, GWM, Lexus and Tata (South Africa.info 2008; Muller 2009:1; Van der Merwe 2009).

As economic isolation and protection began to wind down after apartheid, the government helped the automotive industry adjust to international competition through the support of the Motor Industry Development Program (MIDP). South Africa is now at a crossroads as the MIDP comes to an end. It still must address weaknesses with regard to labour market rigidity and unrest, lack of skilled technicians, low levels of research and development (R&D) and insufficient supplier depth (Alfaro, Bizuneh, Moore, Ueno & Wang 2012:2).

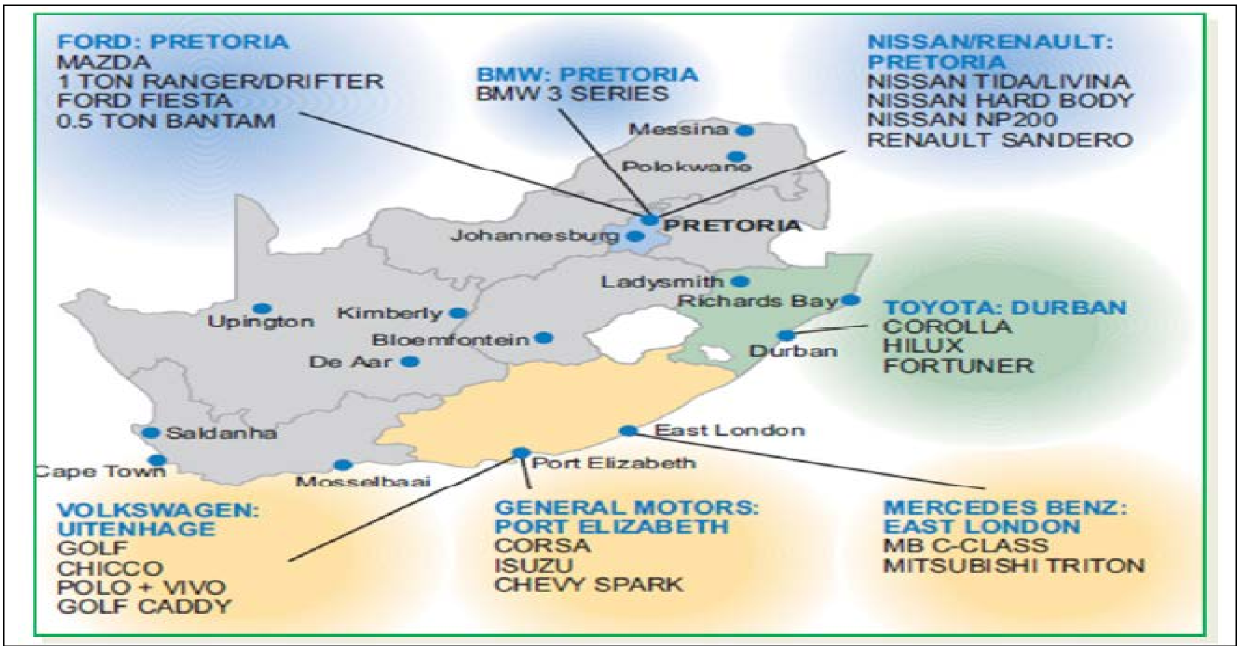
A growth catalyst has been the government's Motor Industry Development Programme (MIDP). Introduced in 1995, the programme is legislated until 2009 and will be gradually phased out until 2012. The MIDP has boosted exports by enabling local vehicle manufacturers to include total export values as part of their local content total, then allowing them to import the same value of goods duty-free. There are more than 200 automotive component manufacturers (ACMs) in South Africa. Some ACMs export their products. These exports include engines, silencers and exhausts, radiators, wheels and tyres, stitched leather car seat covers, car radios, sound systems and axles. There are about 1 400 variants of cars, recreational vehicles and light commercial vehicles in the South African market (Muller 2009:2).

3.3.2 Origins of the South African automotive industry

The South African automotive industry dates back to the 1920s when Ford and General Motors established assembly plants in the country, in 1924 and 1926 respectively. The result was acceleration in new car sales from about 13 500 units to 20 500 units between 1925 and 1929. The onset of the Great Depression in the 1930s halted the expansion of the industry until 1938-1939 after which car sales picked up again. A third assembly firm, the National Motor Assembly of Johannesburg, entered the market in 1939. In the aftermath of the Second World War, the South African automotive industry grew further and even faster. In 1945, the assembly plants, Motor Assemblers and Car Distributors Assembly, were established in Durban and East London respectively. The Chrysler Corporation established a plant in Cape Town, closely followed by South African Motor Assemblers and Distributors in Uitenhage in 1948 and later by the British Motor Corporation in Cape Town in 1955 (Onyango 2000). All these assembly plants assembled completely knocked down (CKD) imported kits.

Major international assemblers and manufacturers have established operations in South Africa, including original equipment manufacturers (OEMs) from traditional manufacturing powerhouses in the USA, Japan and Europe. The most important assemblers include Toyota, Mercedes Benz, Ford Motors, General Motors, Nissan, Mazda and others. Ford Motors was established in South Africa in 1924. Toyota and Ford currently represent the top firms in the industry with the highest levels of production capacity and employment. The main automotive assemblers have concentrated their operations in four South African cities: Pretoria; Durban; East London; and Port Elizabeth (Alfaro et al 2012:15). The domestic market expanded rapidly and the production of cars reached 87 000 units in 1960, a level higher than in any other developing country at the time. Currently, the automotive manufacturing industry in South Africa consists of eight light vehicle assemblers (see table 1.1) and 11 producers of medium and heavy commercial vehicles. Toyota is the major producer (in terms of market share) of both cars and light commercial vehicles. Despite the importance of the automobile industry in South Africa and its role on the African continent, the industry still has a long way to go before it becomes a significant player in the global automotive industry (Kaggwa 2008:3). Most of the global motor vehicle branded manufacturers are represented in South Africa. These include Toyota, BMW, Volkswagen, DaimlerChrysler, Nissan, General Motors, Ford (incorporating Mazda, Land Rover and Volvo) and Fiat (Kaggwa 2008:3; Muller 2009:2). Figure 3.1 presents OEMs in South Africa and their location.

Figure 3.1: Location of assembly plants for OEMs in South Africa



Source: Alfaro et al (2012:15)

As indicated in figure 3.1, South Africa's vehicle manufacturing industry is concentrated in three of the country's nine provinces, namely Gauteng, the Eastern Cape and KwaZulu-Natal, and in close proximity to suppliers. Some automotive development is increasingly also taking place in the Western Cape (NAAMSA 2012:15).

3.3.3 South Africa's automotive industry policy

In South Africa, automotive production started in the 1920s. Government used tariff regulation and local content requirements to the guide growth in the industry (Kaggwa 2008:4). The initial phase that lasted until 1961 was classical import substitution, favouring simple assembly in the domestic market. Extremely high protective tariffs on imports created space for development of an industry of small plants, producing many models in small volumes at a high cost (DTI 2004:8; Kaggwa 2008:4). By the early 1990s, it was evident that the hitherto inward-looking policy stance was not sustainable in the long run. In addition, the industry had to comply with the General Agreement on Tariff and Trade (GATT) and World Trade Organisation (WTO) trade regulations (Damoense & Simon 2004:252; Kaggwa 2008:4). Domestic market constraints meant that exports had to play a huge role in industry growth. Government realised that the industry needed encouragement with a number of "sticks and carrots" to change and improve its competitiveness (Muller 2009:2). Of major importance to government was finding ways in which to maintain and grow the industry in a less protected trade environment (Meyn 2004:8; Kaggwa 2008:4). Table 3.3 summarises the development stages of South African automobile industry policy.

Table 3.3: Development of automobile policy in South Africa

Policy measures	Period
1. High tariffs	1920 - 1995
2. Local content requirements by mass	1961 - 1987
3. Local content requirements by value	1989 - 1995
4. Import-export complementation (MIDP)	1995 - date
5. Productive asset allowance (MIDP)	2000 - date

Source: Adapted from Damoense & Simon (2004:252)

3.3.4 Motor Industry Development Programme (MIDP) and the South African industry

South Africa's isolation under apartheid, brought about by trade boycotts and sanctions, reinforced an inward-looking, high-cost and uncompetitive manufacturing production base where exports were dominated by primary products. Over the last few decades, the South African automotive industry has undergone major policy reforms in that a process of structural changes was implemented to enhance competitiveness and increase value-added production and exports. In addition, changed government support and tariff liberalisation have been significant drivers of the development and performance of the local automotive industry in recent years (Damoense & Simon 2004; Franse 2006: 42).

The MIDP was initiated in 1995 to help the motor industry adjust to South Africa's reintegration into the global economy (Flatters & Netshitomboni 2006:3). The MIDP was intended to enhanced component exports, international competitiveness, and stabilising long-term employment and attracting foreign investment are the core objectives (DTI 2004;

Flatters & Netshitomboni 2006:3). Past developments in the motor industry have received considerable positive publicity in recent years. This is as a consequence of rapid export expansion, initially of components and later of vehicles. Also, the industry has been a recipient of considerable foreign direct investment (FDI) in assembly plants and component production. Trade liberalisation, globalisation of markets and government support has been significant drivers of the development and performance of the local automotive industry in recent years (Franse 2006: 43).

The MIDP has played an instrumental role in promoting this scale of investment and has frequently been cited as a successful example of trade and industrial policy. "One successful outcome of the industry's performance has been the strong export growth of both automobiles and auto components under the MIDP, due to the government's protected export promotion strategies offered to vehicle and component manufacturers" (Damoense & Simon 2004:252). The basic idea of an import substitution and export promotion strategy is that protection is necessary for most developing countries at some point in order to establish an internal routine that generates increasing welfare, as maintained by Chenery and Srinivasen (1989). These authors also maintain that exports make possible the importation of capital goods necessary for investment and prevent balance of payments problems, which seem to plague many developing countries (Myen 2004:10; Flatters & Netshitomboni 2006:4).

3.3.5 Automotive Production Development Programme (APDP)

The new Automotive Production Development Programme (APDP) (to be introduced in 2013), which aims to double vehicle production to 1,2 million units by 2020, with an associated increase in localisation, will reflect a quantum leap in terms of processes, technologies and the scale on which the domestic industry currently operates. The APDP seeks to shift the emphasis away from an export focus to one that emphasises scale in the production of vehicles. In addition the programme intends to support the further development of world-class automotive component manufacturing (NAAMSA 2012:15).

3.3.6 Key role players in the South African automobile industry

The South Africa automobile industry comprises eight light vehicle manufacturers (OEMs) (passenger cars and light commercial vehicles) producing 18 models and served by over 400 ACMs (NAAMSA 2009a:40). Three OEMs have extended their operations to include the assembly of medium and heavy commercial vehicles. No new OEMs had entered the light vehicle manufacturing sector after the implementation of the MIDP in 1995 up to 2008. In August 2008, Fiat Auto SA (Pty) Ltd discontinued vehicle production in South Africa owing to the termination of a contractual arrangement with Nissan SA (Pty) Ltd, and the final vehicle came off the production line during the first half of 2008. Since 2008, Fiat has been operating as an independent importer of CBUs into the country (Lamprecht 2009:237).

The key role players in the South African automotive industry are all part of the Motor Industry Development Council (MIDC). The MIDC was established in 1996 as a joint industry-government-labour body that has a major influence on strategies and policies for the automotive sector. The MIDC provides an effective platform for communication and cooperation and for all the relevant stakeholders to interact on automotive issues. The stakeholders in the automotive industry include government, labour and business (DTI 2004:99; Lamprecht 2009:238). Table 3.4 shows the role players in the South African automotive industry.

Table 3.4: Key role players in the South African automobile industry

Stakeholders	**Body**
Government	• The Enterprise and Industry Development Division (EIDD) • The International Trade Administration Commission (ITAC) (formerly the Board on Tariffs and Trade – BTT) • The South African Revenue Services (SARS – Customs and Excise Department) • The South African Bureau of Standards (SABS)
Labour	• The National Union of Metalworkers of South Africa (NUMSA)
Business	• The National Association of Automobile Manufacturers of South Africa (NAAMSA) • The National Association of Automotive Component and Allied Manufacturers (NAACAM) • The Retail Motor Industry Organisation (RMI) • The South African Tyre Manufacturers Conference (SATMC) • The Catalytic Converter Interest Group (CCIG)

Source: Lamprecht (2009:238)

Several subcommittees have been formed to provide expert advice on relevant matters. The MIDC has been actively involved in issues such as monitoring MIDP developments through its Monitoring Committee. Four MIDC task teams were established in 2003 to investigate and resolve concerns in the areas of vehicle affordability, raw materials, automotive employment as well as free and preferential trade-related agreements. As noted by Lamprecht (2009:238), more recently, in 2009, a BEE task team was established to focus on an empowerment plan for the automotive sector.

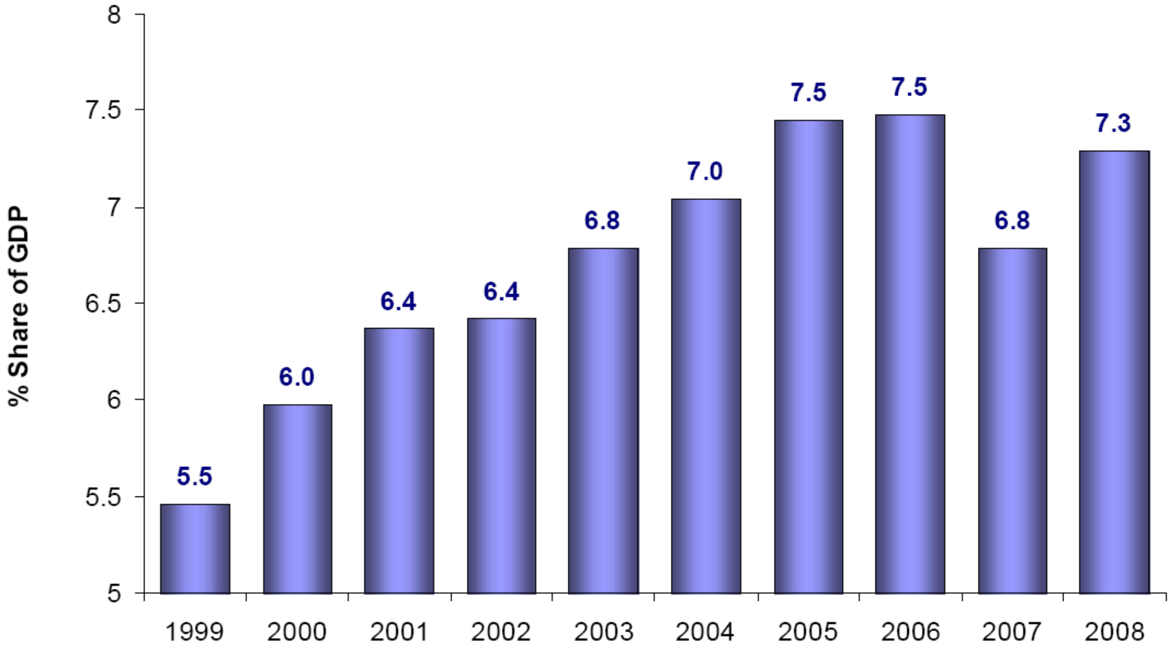
3.3.7 Characteristics of the South African automotive industry

3.3.7.1 Contribution to GDP

South Africa's automotive industry is an important part of the country's economy, representing around 6,2% of GDP in 2010. Around 2,9% of GDP was in the form of vehicle and component manufacturing. The automotive cluster also contributes over 20% of total sales in the manufacturing industry. In 2009, the global economic crisis reduced exports by 35%, production volumes by 34% and the work force by 15% (a loss of 10 000 jobs). The cluster's performance has been recovering in the last two years, although employment is still stagnating (Alfaro et al 2012:19).

The automotive industry's contribution to GDP takes account of the value added in the broadly defined automotive sector and covers vehicle retail, distribution, servicing, auto parts production and vehicle production. Despite the economic slump (2008-2009), the automotive industry has recovered well and vehicle sales have continued to grow and indicate sustainable growth (Piderit, Flowerday & Von Solms 2011). For instance, Mercedes-Benz South Africa's East London assembly operation is the largest private sector employer in the Eastern Cape and has invested considerably in relieving the socioeconomic issues faced by the local community (Piderit et al 2011). The motor sector contributed to GDP levels of an all-time high of 7,4% in 2006 (NAAMSA 2009a). The industry's contribution to South Africa's GDP during 2008 increased to 7,29% from 6,79% in 2007 (NAAMSA 2009a). Figure 3.2 shows the contribution of the automotive industry to GDP.

Figure 3.2: Contribution of the South African automotive industry to GDP

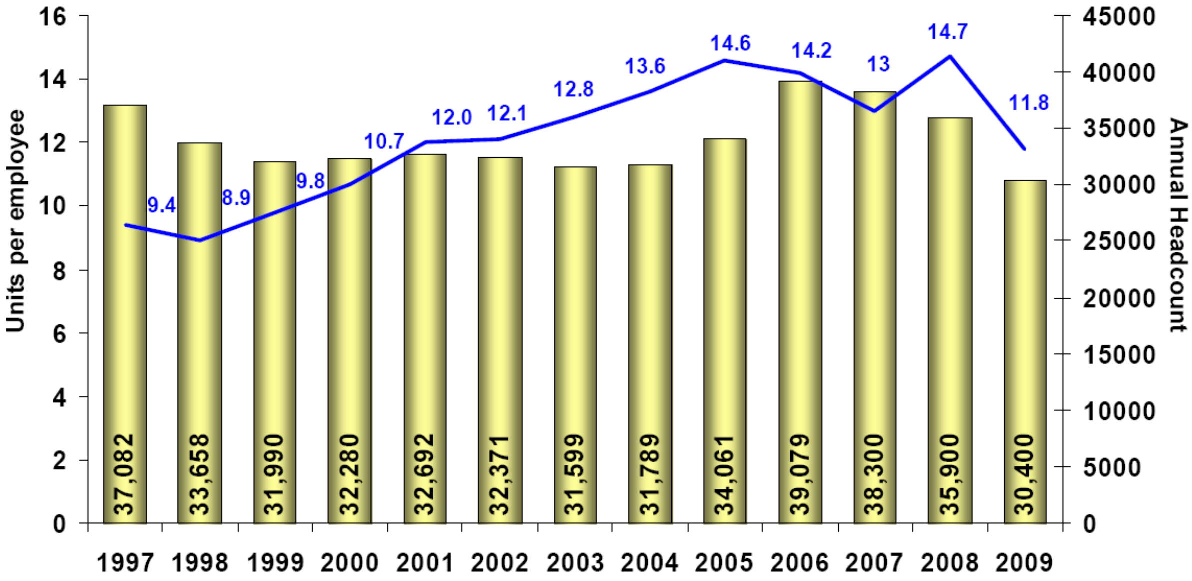


Source: Powels (2009)

3.3.7.2 Employment levels and trends

The automotive industry is one of the main contributors to employment in South Africa. For a decade, the automotive industry employed in access of 30 000 people (Powels 2009). However, the number of people employed by new vehicle manufacturing showed a decline during the first quarter of 2009. Compared to 28 128 positions at the end of 2010, aggregate industry employment improved by only 51 jobs during the first quarter of 2011 to 28 179 jobs, a marginal improvement of 0,2%. In 2008, the automotive industry recorded an aggregate employment of 34 963 positions. Aggregate industry employment declined by 2 571 jobs during the first quarter of 2009 to 32 392 jobs. The magnitude of the extremely difficult operating environment, was both characterised by sharply lower domestic new vehicle sales and lower export sales, which is illustrated by the decline in headcount of 2 571 jobs during the first quarter of 2009, compared to a decline for 2008 when jobs declined by 2 566 (NAAMSA 2009a). However, according to NAAMSA (2010b), there are encouraging increases in aggregate industry employment levels with the headcount increasing by 427 positions during the second quarter on top of the 1 196 new jobs created in the first quarter. Figure 3.3 shows South African automotive employment for 13 years from 1997 to 2009.

Figure 3.3: South African automotive industry 13-year employment statistics



Source: Powels (2009)

3.3.7.3 Vehicle production and sales

According to Mbiko (2007:2), South Africa produced 78,7% of Africa's vehicle production in 2005. This is relatively small in international terms, with less than 1% of global market share and the country ranked 19th by size globally, in 2005. According to table 2.7 (Vermeulen 2007:2), new global motor vehicle production in 2006 reached 69 212 755 units. The South African vehicle manufacturing industry's share of world production has risen steadily in recent years, from 0,7% in 2004 to 0.85% in 2006 (Naude 2009:32). The world's new motor vehicle production in 2008 reached 70 192 549 million units (in 2007 73 189 954 million units were produced). This represents a decline of 2,99 million vehicles produced (or 4,1%) compared to the 73 189 953 million new vehicles produced globally during 2007. Table 3.5 shows the South African vehicle manufacturing industry's share of world production an improved by 9,6% during 2008 (NAAMSA 2009b).

Table 3.5: The South African automotive industry's performance in global context

	2000	2004	2005	2006	2007	2008	2009	2010	2011
Global Vehicle Production	58,0 million	64,49 million	66,55 million	69,33 million	73,18 million	70,19 million	61,70 million	77,62 million	80,09 million
SA Vehicle Production	0,357 million	0,455 million	0,525 million	0,588 million	0,535 million	0,563 million	0,374 million	0,472 million	0,533 million
SA Share of Global Production	0,61%	0,70%	0,79%	0,85%	0,73%	0,80%	0,61%	0,61%	0,66%

Source: NAAMSA (2009b)

According to NAAMSA (2009b), 2009 was an extremely difficult year for the global as well as the entire South African automotive industry. All sectors of the South African automotive industry: retail; auto parts manufacturing; and vehicle production experienced severe and unprecedented viability challenges. The operating environment in all three sectors of the industry, during the first few months of 2009, deteriorated substantially and showed modest improvement, domestically, during the second half of the that year and, internationally, once the severe global financial and economic crisis dissipated. Improvement in the domestic environment is dependent on a revival in consumer expenditure, lower inflation, aggressive interest rate reduction and fiscal stimulation (NAAMSA 2009b). Nevertheless, there is steady growth in the industry as a sign of recovering from recession (NAAMSA 2010b). Global new motor vehicle production in 2011 reached a record of 80 092 840 units (2010 saw 77 629 127 units). This represents an increase of 2,5 million vehicles produced or 3,2% compared to the 77,6 million new vehicles produced during 2010. In contrast, South African vehicle production rose to 532 545 vehicles in 2011 from 472 049 units produced in 2010, an improvement of 60 496 vehicles or 12,8% (NAAMSA 2012).

With reference to sales, NAAMSA (2009a) denotes passenger car sales at 60 043 units recorded a decline of 25 726 units or 30,0% compared to the 85 769 new cars sold during the corresponding quarter of 2008 in South Africa. Combined, commercial vehicle sales during the first quarter of 2009 at 33 242 units reflected a fall of 22 173 units or a decline of 40,0% compared to the 55 415 units sold during the corresponding quarter of 2008. For the 2010 first quarter aggregate, industry reported passenger car sales at 81 450 units, which is an exceptional increase of 14 371 units or 21,4% compared to the 67 079 new cars sold during the corresponding quarter of 2009. Combined commercial vehicle sales during the first quarter of 2010 at 39 446 units recorded an improvement of 3 464 units or 9,6% compared to the 35 982 units sold during the corresponding quarter of 2009 (NAAMSA 2010a).

3.3.7.4 Trade and exports

In 2010, the automotive industry exported left and right-hand drive vehicles to 77 destinations. The industry manufactures motor cars, light commercials, medium commercials and trucks and buses. The total export value of manufactured vehicles reached R425 737 billion in 2010. These exports consisted mostly of motor cars, representing around 65% of total exports, followed by light commercial vehicles with 29% (Alfaro et al 2012:18). Also, in 2010, South Africa provided 0,61% of total production of vehicle manufacturing worldwide and was ranked 24th for vehicle production in terms of global market share. The number of export destinations (with value exceeding R1 million) increased from 62 in 1995 to 131 in 2010. Further trade and business partnerships have been developed with the important trading blocs, such as the EU, NAFTA, Mercosur and African regions. In 2010, South Africa's main automotive trading partners, in terms of added exports and imports, were advanced economies, Germany with 43% of total trade, Japan with 19% and the USA with 18% (Alfaro et al 2012:14). In 2010, the automotive industry exported left and right-hand drive vehicles to 77 destinations.

3.4 AUTOMOTIVE SUPPLY CHAIN MANAGEMENT PRACTICES

3.4.1 Introduction

This section of the chapter discusses the framework of SCM in the automotive industry and the changing structure of the automotive supply chain and reviews supply chain challenges in the global automotive supply chain and in the South African automotive industry.

3.4.2 Supply chain management framework for the automotive industry

The automotive industry is divided into upstream suppliers (automotive component manufacturers or ACMs), original equipment manufacturers (OEMs), and downstream dealers and distributors (Braese 2005:13). Lamprecht (2009:160) asserts that the automotive supply chain integrates four groups of players: OEMs, first-tier suppliers, sub-tier suppliers and infrastructure suppliers in the supply side of auto manufacturing. Another part that is not within the automotive vehicle manufacturing supply chain, although it is related, is the aftermarket. Different types of technologies are used to establish the links between the groups. According to Wei and Chen (2008:974), the automobile industry comprises auto companies, auto parts suppliers and auto sales. The relationships within the automotive supply chains tend to be fixed and clearly demarcated. Hence enormous potential exists for shaping the relationships between these players to make them more interactive. The industry has a tendency to reduce inventory levels rapidly, forcing automotive component companies to redesign and expand their SCM initiatives (Hugo et al 2004:76).

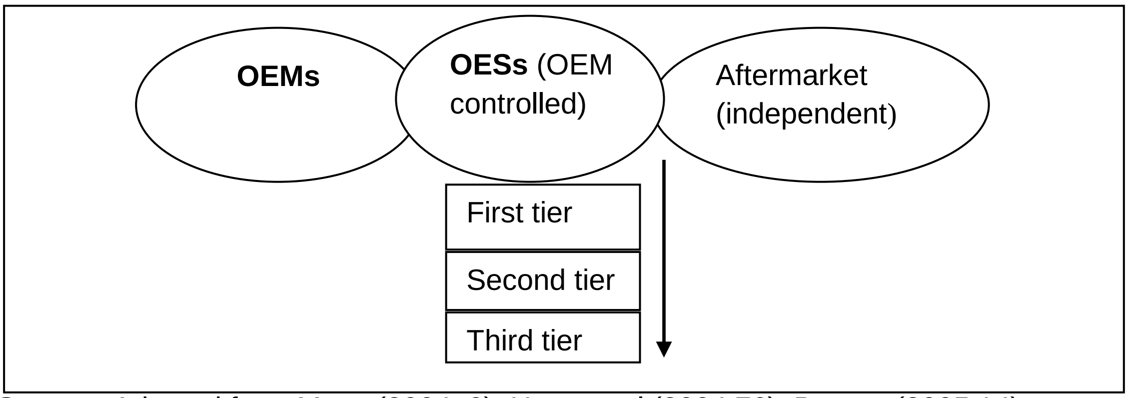
The automotive supply chain stretches from the producers of raw materials through to the assembly of the most sophisticated electronic and computing technologies (Tang & Qian 2008:288). Suppliers are generally tiered from the manufacturer's perspective. This means that if a supplier directly delivers product to the manufacturer, they are a first-tier supplier. First-tier suppliers are the closest to the OEMs in the supply chain, and provide larger modules and parts for final assembly. The second and third tier usually source raw materials and supply components and smaller modules to the first tier. Generally there are many more tiers of parts suppliers, relative to the manufacturer. Beyond those tiers are the raw materials suppliers. The number of second- and third-tier suppliers is often in the thousands, while a manufacturer might only have tens to hundreds of first-tier suppliers (Braese 2005:13).

First-tier suppliers (ACMs) are becoming increasingly important as design is pushed up the supply chain by OEMs. They are starting to build whole sections of vehicles in the form of modules. This means that suppliers have to adapt by gaining new expertise. At the same time they are being pressured by OEMs for price reductions. This puts them in a bad situation, as they also have to deal with rising raw material costs and it is difficult to improve efficiency to maintain the margin (Braese 2005:13). OEMs market vehicles, complete final assembly of modules and components and usually ship cars and trucks to distributors via rail. Manufacturing is divided up into several categories of vehicles, which are passenger cars, light, medium, and heavy trucks. In automotive retail dealers receive vehicles by truck either directly from the manufacturing plant, or from a vehicle distribution centre. Dealers generate revenue from the sale of new cars, used cars and service parts. An important distinction here is that service parts and accessories have different and separate supply chains, but are still sold at dealerships. Parts in the aftermarket may come from component suppliers as well the OEMs to repair, maintenance, and customisation shops (Braese 2005:14).

The aftermarket is involved with all purchases relating to the vehicle for repair, maintenance or customisation after the original sale. The aftermarket focuses on light vehicles and the heavy-duty aftermarket, which focuses on medium and heavy weight trucks (Braese

2005:14). Figure 3.4 shows an integrated framework of the constituent parts of the automobile supply chain.

Figure 3.4: Constituent parts of the automotive supply chain



Source: Adapted from Myen (2004: 9); Hugo et al (2004:76); Braese (2005:14).

Hence, as indicated above, the automotive supply chain is composed of the following segments with distinct requirements (Lamprecht 200616):

- **Original equipment manufacturers (OEMs**). This segment is comprises passenger cars, commercial vehicles and bus manufacturing as well as sales, from primary through to dealerships.
- **Original equipment suppliers (OESs).** This segment is made up of suppliers who manufacture and supply automotive parts and accessories directly to OEMs for their service networks. Parts receive reliability associated with the brand of the vehicle. Ideally parts or accessories serve for up to nine to ten years after production of the vehicle. OESs require global coverage and need to provide “black box” solutions (solutions created by suppliers using their own technology to meet the performance and interface requirements set by the OESs).
- **The independent aftermarket**. This segment is responsible for the manufacturing and sales of automotive replacement parts and accessories through independent retailers and repair shops directly to the consumer instead of to the OEMs. The aftermarket also remanufactures, distributes, retails and installs motor vehicle parts and products, other than the original parts and accessories.
- **First-, second- and third-tier automotive component manufacturers (ACMs).** This segment is involved with the supply of manufactured parts and accessories to OEMs, OESs and the independent aftermarket. The distribution between the different tiers of component suppliers is indicative of the component manufacturer’s role in the

value chain. First-tier suppliers (also known as sub-assemblers) are responsible for manufacturing components that are supplied to OEMs and the aftermarket. In some instances they design certain assemblies and assembly modules, such as entire dashboards from different components, and are then referred to as tier 0,5 suppliers. They require design and innovative capabilities, but compared with OESs, their global reach may be limited. Second- and third-tier suppliers provide parts for first-tier suppliers and also OEMs, depending on the product. Third-tier suppliers supply most basic products and generally only rudimentary engineering skills are required.

In South Africa, the automotive supply chain includes manufacturing, distribution and maintenance and servicing. The industry has significantly evolved in the past 57 years, transforming itself from a mainly importing industry to an increasingly self-sufficient one. The industry has been able to increasingly integrate its operations throughout the entire value chain (Alfaro et al 2012:16). The industry is supported by related industries at the different stages of the supply chain. It relies on products and services from more than 304 vehicle component manufacturers, 2 907 parts dealers, 220 frame vehicle and equipment suppliers, 192 vehicle body builders, 483 engine reconditioners, 1 374 new car dealerships with franchises, and 1 898 specialist repairers. Suppliers for the manufacturing process include both domestic and international firms. The industry's value chain begins by utilising basic materials from third-tier suppliers, which are supported by other relevant South African clusters including mining and livestock. These initial suppliers then provide inputs to second- and first-tier suppliers, who then provide the necessary manufactured inputs for final vehicle assembly. The subsequent stages of retail and distribution are supported by dealerships, marketing, financial services, vehicle maintenance, transportation and logistics (Alfaro et al 2012:16).

3.4.3 Changing structure of the automotive supply chain

The automotive industry has undergone a transformational evolution over the last two decades (Cooney & Yacobucci 2005; Swieki & Gerth 2008:2). Historically, the industry operated under a "push" model. In this model, marketing and sales take a best guess at market demand and then feed these forecasts into the design, engineering, financial and manufacturing teams to determine make and/or model production volumes (Howard, Miemczyk & Graves 2006:91). With the boom of the Internet, data have become much more accessible to both manufacturers and consumers of automobiles. (Tang & Qian, 2008:288). The industry focused primarily on lean, "just-in-time" manufacturing processes and their supporting technologies. Because the price tag for re-engineering and supporting technologies, for example ERP was prohibitively high, efforts were limited to OEMs and their first-tier suppliers. Significant progress was made to "commonise" process and technology within the "four walls", but these efforts created a widening process and technology gap between OEMs, first-tiers and the rest of the automotive supply chain (Van Biljon 1998:130; Stevenson 2009:694). As the Internet became a common fixture in automotive B2B, competitive pressures grew exponentially (Tang & Qian 2007:288).

Real-time sharing of design, planning, production, logistics and sales information have served to make the "global automotive industry" truly global. Globalisation has added complexities and costs to capture and maintain market share (Zhang & Chen 2006:668; Swieki & Gerth 2008:2). In Asian markets, more than 20 new OEMs, joint ventures and thousands of suppliers were positioning to capture a piece of the projected 140 million new vehicle owners in China. In Eastern Europe, lower cost structures and the availability of highly skilled labour enticed OEMs and suppliers to establish new facilities, technology and design centres. Point-to-point technology solutions were used to leverage the ubiquitous, low-cost capabilities of the Internet. Portals, marketplaces and auction sites popped up everywhere promising to revolutionise the industry. With the burst of the Internet bubble, a more rational reality set in (Zhang & Chen 2006:668). Starting with business process, OEMs and first-tier suppliers looked to extend demand-driven capabilities to 100% of the supply chain. In mature markets, automotive firms face stiff competition and demanding customers. The implementation of mass production which is forecast driven has led to overstocking, extra marketing expenses and low profitability (Holweg & Pil 2004; Zhang & Chen 2006:668). Today many vehicle manufacturers (VMs) have adopted mass customisation and a customer-driven strategy in the hope that the drawbacks of mass production can be overcome.

The automotive industry is known as a typical industry adopting mass production as its standard strategy of production. For example, the Ford Motor Company limited production to the model T for 19 years (Zhang & Chen 2006:668). Traditional mass production relies heavily on a company's ability to forecast demand accurately, which in turn guides the firm's decisions about operations and production. Characterised as a push system, forecast-driven production is a highly efficient but somewhat rigid system that utilises historical data and projections to create a production plan and makes use of existing configurations to produce products for stock (Zhang & Chen 2006:668). However, with changing demands and a shift to mass customisation, forecast-driven production may no longer be capable of coping with a rapidly changing market. The firm's operations are initiated by customer orders not forecasts (Holweg, Disney, Hines & Naim 2005; Zhang & Chen 2006:669). A customer-order-driven production approach includes the flow of material, goods and information. This is characterised as a pull system that produces products for specific customer orders in a timely manner, thus avoiding stockpiles (Zhang & Chen 2006:669).

Mondragon, Lyons, Michaelides and Kehoe (2006:552) advocated that the past decade has witnessed the consolidation of diverse SCM models. Retail and grocery supply chains have pioneered the use of vendor-managed inventory (VMI), efficient consumer response and collaborative planning, forecasting and replenishment initiatives. Electronics-computer-semiconductor supply chains have been redesigned to support efficient, build-to-order (BTO) product manufacturing and vehicle manufacturers have witnessed the advent and maturation of sequenced supply from first-tier suppliers on adjacent supplier parks. Material and cargo movements are being tracked using global positioning systems and third- and fourth-party logistics providers are coordinating the intermodal transportation of goods.

Traditionally, automotive supply chains have revolved mainly around making supplier collaboration and manufacturing operations more efficient. However, the dynamics of the marketplace have changed. Today, OEMs and suppliers, their sales distribution companies and dealers are the key components of the emerging global automotive ecosystem and are poised to become the new and increasingly important links to growing revenue, market share and profits (Lam 2008). Some of the development of supply chain in the automotive industry includes global restructuring among major competitors, changes in overall geographical production and manufacturing techniques (Kim & McCann 2008:256).

Some of the developments resulting in the changing structure of the automotive industry are discussed below.

3.4.3.1 Globalisation

Globalisation is a key factor in the overall strategy of automotive suppliers (Wyman 2008:4). It is a trend reflected in the reduction of trade barriers, deregulation of commerce and the use of information technology (IT) to facilitate links to potentially anywhere in the world. According to Zhao and Lv (2009:28), globalisation has generated two kinds of suppliers in the auto industry, global and local. Giant firms either export parts to offshore assembly plants or depend on local suppliers in each production location (Cooney & Yacobucci 2005:63; Sturgeon, Memedovic, Van Biesebroeck & Gereffi 2009:8). Apart from increasing competition in every market, globalisation affords organisations the opportunity to find synergies and reduce costs (Mondragon et al 2006:551). Wyman (2008:4) notes that the major determinant of future viability is an increasingly competitive and international sectoral environment.

The consequences of globalisation as noted by Lamprecht (2009:159) include the fragmentation of market to lower product units; dissatisfaction with the costly system of building cars for stock, not to order; innovative modular construction in which increasingly parts of a car are assembled by parts suppliers; and a possible switch to alternative-energy powered cars. Major automotive manufacturers have expanded the foreign share of production in recent years especially to developing countries (Sturgeon et al 2009:9).

3.4.3.2 Outsourcing

Outsourcing involves the use of specialists to provide competence, technologies and resources to parts of the whole (Zhao & Lv 2009:29). It allows greater economies of specialisation (European Monitoring Centre for Change 2004:7). Outsourcing is becoming one of the main strategies adopted by organisations that find it increasingly difficult and less economical to produce for their needs on their own (Mondragon et al 2006:552). The use of outsourcing (or contracting) is important and growing in a range of industries, including electronics, pharmaceuticals, medical devices, automotive and food and beverage production. Increasingly, firms that traditionally manufactured their own products are now outsourcing production and focusing on product design, development and marketing (Plambeck & Taylor 2005:126). Recent advances in technology and management expertise have changed thinking on how global businesses are organised. The changes are driven mostly by two factors: first, the cost structure made possible by new technologies; and second the complexities in business products and processes that are the result of companies exploiting new technologies. According to Zhao and Lv (2009:29), the automotive industry will continue to outsource from low-cost countries as manufacturers and suppliers continue to supplement their commodities with more complex products and services.

3.4.3.3 Modularisation

Modularity has become one of the most prevalent means to supporting product variety and achieving mass customisation (Lin, Zhou, Shi & Ma 2009:323). Doran and Roome (2003:521) describe modularity as the process of "building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole." It is a dispersed assembly system where some activities are pre-assembled and others are in a final assembled system (Fredriksson 2006:351). Modular architecture promised to make standardisation possible and offered a strategy for designing and mixing sets of standard components to provide maximum variety to the customer (Doran 2004:102).

According to Lin et al (2009:324), Volkswagen and Mercedes-Benz (owned by Daimler-Chrysler since 2000) were the first automakers to introduce modularity into the automotive industry, beginning in 1996 (plant in Resende, Brazil) and 1997 (plant in Hambach, France). However, the most visible example of the trend towards modularisation is the "Smart" car collaboration between Mercedes-Benz and the watchmakers, Swatch. Mercedes-Benz and Swatch took an innovative design, a purpose-built plant and a new supply base designed specifically to accommodate modularisation of the Smart car (Doran 2004:102; Doran, Hill, Hwang & Jacobs 2007:317). The benefits associated with modular provision seem to relate primarily to the increased ability to accommodate new product variations in a shortened life-cycle environment and at lower cost, representing changes in both market structure and market demands (Doran et al. 2007:3).

3.4.3.4 Supplier parks

A supplier park is the co-location of supplier facilities. It has been described as the choice of individual suppliers to set up a dedicated facility close to a customer (Howard et al 2006:92). An automotive supplier park is a network form of organisation that is neither market nor hierarchy (Sako 2005:3). A supplier park is defined as a concentration of dedicated production, assembly, sequencing or warehousing facilities run by suppliers or a third party in close proximity (ie within 3 km) of the OEM plant (Howard et al 2006:92). The number of automotive supplier parks has grown over the past decade, especially in Europe, and currently totals 23 sites. Most OEMs have implemented some kind of Supplier park, including Ford, GM, Fiat, Peugeot, Renault, BMW and Volkswagen. Automotive supplier park activities include warehouse and inventory management, sequencing, manual assembly and late configuration, and range in size, consisting of between seven and 24 suppliers (Sako 2005:3).

The decision to co-locate a supplier facility near the OEM assembly plant can also be driven by a need for volume flexibility, for example, where capacity is taken by an additional assembly line. The cost to hold this inventory may be shifted to the supplier instead of making use of an OEM-controlled warehouse. A significant driver for setting up a co-located supplier facility is the opportunity for funding development of local production sites. Regional and local development agencies often have funds to establish production sites, especially in areas identified as economically disadvantaged, for example, where European structural funds are made available. Regional development agencies may then approach large production facilities to offer them a subsidised infrastructure for further development of production facilities to encourage economic growth (Howard et al 2006:94).

3.4.3.5 Need for build-to-order

Intensified global competition has led automakers to institute a “build-to-order” approach in which consumers define the desired features of their vehicles before they are produced (Zhao & Lv 2009:30). In the more traditional prevalent “build-to-forecast” approach, production is based on forecast demand and information received from dealers regarding prior sales (Holweg & Pil 2004). Recent industry analysis has shown a rise in auto body styles, colours and options. Traditional car models such as sedans, vans, hatchbacks and pick-up trucks are fragmenting increasingly into niches. Derivative car models, however, such as coupes, roadsters, minivans and two-seaters, and crossover vehicles such as fourdoor coupes, SUV coupes and sport vans are growing. Auto experts suggest that build-to-order is gradually taking hold (Veloso & Kumar 2003). In Germany, 62% of cars sold are built-to-order, the highest share of all the major markets (Zhao & Lv 2009:30).

3.4.4 Supply chain integration practices in the automotive industry

The automotive industry has complex organisational interrelations of dependence between the various tiers of the automotive components sector and transnational vehicle assemblers, which depend on key integration practices to achieve a competitive advantage (Sturgeon et al 2009:10). Supply chain integration is a function used to lock the large and important tiers of component suppliers into dependency relationships, called “global connectivity” (Barnes & Morris 2008:34). A greater degree of integration in the automotive industry has developed at the level of design, as global firms have sought to leverage design efforts across products sold in multiple end markets (Barnes & Morris 2008:34). The work of vehicle design and development continues to be concentrated in or near the headquarters of lead firms. In addition, suppliers of parts have taken on a larger role in design and have established their own design centres close to their major customers to facilitate collaboration. Because centrally designed vehicles are tailored to local markets and parts are manufactured in multiple regions to the degree possible, design activities and buyer–supplier relationships typically span multiple production regions. This has resulted in local, national and regional value chains in the automotive industry being “nested” within the global organisational structures and business relationships of the largest firms (Sturgeon et al 2009:10).

Kwon and Suh (2005: 26) consider supply chain integration to be a strategic tool that aims to reduce costs and thus increase customer and shareholder value. Effective supply chain planning, built on shared information and trust among partners, is a vital part of successful supply chain functioning (Naude & Badenhorst-Weiss 2011:76). The basis of integration can therefore be characterised by cooperation, collaboration, information sharing, trust, partnerships, shared technology and a fundamental shift away from managing individual functional processes to managing integrated chains of processes (Power 2005:253). Some of the practices for enhancing supply chain integration are briefly discussed.

3.4.4.1 Forming strategic partnerships

Partnerships are established for improvement of working relationships, spreading risk, increasing market power, pre-empting resources, accessing new markets and gaining organisational learning (Tang & Qian 2008:291). Among the various functions, knowledge acquisition and transfer and generation of technology have been regarded as the primary motives for strategic partnerships in certain industries, especially highly technological ones. Strategic partnerships range from relatively noncommittal types of short-term, project-based cooperation to more inclusive long-term, equity-based cooperation.

According to Tang and Qian (2008:290), the development of strategic partnerships is vital in the automotive OEM for choosing and selecting suppliers for a common goal. A strategic partnership is the interface between an automotive OEM and its partners including its associated suppliers. In the automotive industry today, the trend is “the reduction of direct suppliers to a small number of system specialists” based on strategic partnership. By introducing strategic partnerships, Audi, for example, managed to reduce half of its direct suppliers within a period of four years. In these cases, some capable and effective suppliers called system suppliers are chosen to have direct connections to the automotive manufacturer (OEM) while other suppliers called sub-suppliers no longer directly communicate with the OEM (Tang & Qian, 2008:291).

Fiat and GM signed a partnering agreement in 2001. The reasons for partnering can be characterised in four areas. The first is a "pursuing-where-you-sell" strategy. The second area is widening of the product range in order to satisfy a highly fragmented and differentiated demand and taking advantage of niche market opportunities. The third is achieving cost savings in design (platforms), purchasing (modules and component sharing) and manufacturing (modularity and outsourcing). The last area is reducing the risk associated with the enormous organisational and financial effort required by international strategies that transfer design and manufacturing responsibilities to suppliers (Tang & Qian 2008:291).

3.4.4.2 Long-term relationships

Maintaining good long-term relationships with suppliers is increasingly being recognised as a critical factor in sustaining a competitive advantage (Stevenson 2009:718). Numerous businesses view their suppliers as partners - in other words, these businesses have a stable relationship with their suppliers characterised by comparatively few of them that can deliver high-quality supplies, sustain delivery schedules and remain flexible relative to changes in specifications and delivery schedules (Naude & Badenhorst-Weiss 2011:75). Automotive supply chains can consist of over 300 suppliers, including first, second and third-tier suppliers, and cyclical relationship between trust and information sharing (Piderit et al 2011).

According to Sturgeon et al (2009:21), Japanese lead firms in the automotive industry generally pursue long-term relationships. While co-design with suppliers has been limited in scope, Japanese lead firms have tended to form long-term, paternalistic *captive* relationships with suppliers. This has often involved equity ties between automakers and suppliers, which respond by dedicating themselves to serving their largest customer. In addition, the need for co-design is less because Japanese automakers have kept the design and parts and subsystems almost entirely in-house. Nevertheless, supplier switching without notice, exclusively to reap a short-term gain, is almost unheard of, and long-term, trust-based relationships are allowed to develop (Sturgeon et al 2009:21).

3.4.4.3 Cooperation to improve processes and operations

Cooperation in the supply chain ensures full integration between the main industry and by-products industry for the purpose of increasing the competitive power and sustainability of the automotive industry. “By-products” used in manufacturing processes are developed in cooperation with the main industry and the by-products industry starting from design activities. This process is required for reliability-based cooperation between the main industry and the by-products industry. It also leads to development of competitive products and technologies (Bütüner & Özcan 2011:9).

According to Kuhn (2006:1101), the process of manufacturing a vehicle is split into four stages processes: press shop, body shop, paint shop and final assembly. The production process starts in the press shop where the coils are separated into single sheets and then pressed into the different shapes of inside and outside panels like front fenders or boot lids. In the next stage, the required body parts for one car are either welded or glued together forming the pure body of the car. After washing the body, different processes such as cataphoretic grounding for corrosion protection, sealing of the defined body sections against incoming water and final painting are implemented to obtain a painted body. This body is forwarded to final assembly where most of the parts like steering, engine, seats, front and rear bumpers, wheels and so on are fitted to the car (Kuhn 2006:1101). For this process, cooperation with strategic partners is essential.

Hence operations of automotive manufacturers depend on a substantial network of suppliers (Piderit et al 2011). Many multinational automotive OEMs and component suppliers have realised that operations in South Africa, for example, can provide an opportunity for a competitive advantage (DTI 2004). Relative to the size of the South African market, the automotive sector continues to perform well, and has set the standard for the development of other industries within the country, and the Department of Trade and Industry (DTI 2004) thus believes that national, provincial and local governments should continue to ensure the success of this sector (Piderit et al 2011).

3.4.4.4 Collaboration for new product development

Collaboration for new product development provides the benefit of being able to use the expertise of suppliers to make better designed parts that are easier to manufacture. Making parts easier to build can significantly reduce costs and lead times. In order to support collaboration, General Motors, for example, hosts a team of the suppliers' engineers for the development phase of its new products. In so doing, both parties are present during the key aspects of design, and can work with other teams to ensure interoperability with all modules (Braese 2005:59).

According to Braese (2005:59), when an order for new product development is received, information is sent out to signal suppliers. Forecasting schedule takes about 20 weeks in advance, say, for General Motors to build its product. This time period is further broken up into material authorisation and fabrication steps. Material authorisation is usually four weeks long, and during this time the supplier is allowed to procure the parts and raw materials it needs to complete the order. With General Motors, the production period lasts two weeks and allows the supplier to make the specified parts. General Motors also provides a one-year, long-term forecast. This forecast is at the vehicle level, and is primarily used for capacity planning at the supplier level. Hence General Motors collaborates with its suppliers on two types of interactions. The first is working with suppliers for order management, and the second is collaborative, new product design with suppliers (Braese 2005:59).

3.4.4.5 Building supply chain trust

Trust between supply chain partners involves dependability and benevolence. Dependability means that the other party is reliable or can be depended on while benevolence is the belief that the other party will act in the mutual best interest of the supply chain (Goche 2012:7). In order for a supplier to provide a satisfactory level of performance, efficiency and quality, the automobile manufacturer is obviously required to make a serious commitment. This demands a high degree of trust is required. If trust does not exist in the relationship, it would be virtually impossible to expect the level of performance expected from suppliers. The resources and financial obligations necessary to operate require suppliers to genuinely commit themselves to these relationships, with the trust that the manufacturer will do the same. It is this mutual commitment that creates the synergy required to form and maintain the bonds necessary to produce a reliable long-term relationship and the constant push for improved quality (Matsubara & Pourmohammadi 2009:92).

Trust and information-sharing relationships are especially relevant in the automotive industry where manufacturers are under enormous pressure to reduce time to market, increase flexibility and lower costs in order to be competitive (Piderit et al 2011). The existence of trust in the supply chain relationship leads to reduced costs and more efficient and effective operations (Piderit et al 2011). Insufficient trust between supply chain partners leads to inefficient and ineffective operations in the supply chain and consequently impacts negatively on the supply chain's competitive advantage (Covey 2008). According to Kamal (2009:81), Ford, for example has failed to gain trust from and promote sharing with its suppliers. The management of Ford regards the process of building collaborative markets as a chance to create imbalances instead of a way of establishing trustful cooperation.

3.4.4.6 Sharing relevant information

Information sharing is aimed at supporting suitable integration in the automotive OEM process (Tang & Qian 2008:291). Key constructs that support the governance of information sharing and material flow coordination in supply chains, include trust, bargaining power and contracts. Sharing relevant information amongst business partners will depend on the level of trust in the supply chain relationship (Piderit et al 2011). With the complicated network of suppliers that make up an automotive supply chain, the management of the multiple relationships is critical to the success of the supply chain (Dubey & Jain 2005). It stands to reason that sharing relevant information across inter-organisational systems will play a key role in maintaining sound relationships between the supply chain partners (Piderit 2011). For example, BMW makes use of a web-based document management system that allows easy, secure access to shared information with its strategic partners. This is of particular significance in the global setting of multinational automotive suppliers. BMW also encourages the use of a "yellow pages" application to locate experts (Awazu, Desouza, Jha, Kim, & Wecht 2007). This is the most important (and easy to establish) tool for information sharing in multinational automotive supply chains (Piderit 2011).

3.4.4.7 Sharing supply chain risk

Strategic alliances are formed in order to spread risk, increase market power, pre-empt resources, access new markets and gain organisational learning. Among the various functions, knowledge acquisition, transfer and generation of technology have been regarded as the primary motives of strategic alliances in certain industries especially highly technological industries. One key to upgrading the supplier base and improving risk sharing across OEMs and component manufacturers is through strong institutions for collaboration (Alfaro et al 2012:23).

Table 3.6 summaries the benefits of implementing optimal supply chain practices.

Table 3.6: Summary of the benefits of implementing optimal supply chain practices

Practices	**Benefits to the supply chain**
Forming strategic partnerships	Improve working relationships, spread risk, increase market power, pre-empt resources, access new markets and gain organisational learning (Tang & Qian, 2008:291)
Establishing long-term relationships	Ensure stable relationship with comparatively few suppliers that can deliver high-quality supplies, sustain delivery schedules, and remain flexible relative to changes in specifications and delivery schedules (Naude & Badenhorst-Weiss 2011:75)
Cooperating to improve processes and operations	Ensures full integration between the main industry, increases competitive power and sustainability of the automotive industry, leads to development of competitive products and technologies (Bütüner & Özcan 2011:9)
Collaborating on new product development	Being able to use the expertise of suppliers to make better designed parts that are easier to manufacture, parts are easier to build and this significantly reduces costs and lead times (Braese 2005:59)
Building supply chain trust	Provides good levels of performance, efficiency, and quality, ensures serious commitment from partners which leads to the expected level of performance from suppliers (Matsubara & Pourmohammadi 2009:92)
Sharing relevant information	Plays a key role in maintaining sound relationships between supply chain partners, sharing relevant information among business partners depends on the level of trust in the supply chain relationship (Piderit et al 2011)
Sharing supply chain risk	Helps to spread risk, increase market power, pre-empt resources, access new markets and gain organisational learning. Strong institutions for collaboration and information sharing should be encouraged (Alfaro et al 2012:23).

Source: Researcher’s own construction

3.4.5 Supply chain challenges in the South African automotive industry

This subsection discusses global and South African automotive supply chain challenges. While the automotive industry is critical to the South African economy, it faces enormous challenges in the supply chain. The challenges are discussed under the following headings:

technological challenges; infrastructural challenges; cost challenges; market/service challenges; relationships challenges; and production and skills challenges.

3.4.5.1 Technological challenges

Information technology plays a key role in successful supply chain practices. According to Cheng, Lai and Singh (2007), information technology is used to conduct business transactions, share information and facilitate collaboration as the main determinants of a supply chain's effectiveness (Piderit et al 2011). According to the SCIR (2009) report, there is high usage of technology in the South African automotive industry. However, high-use technology is challenged by low levels of collaboration. The industry is faced with further pressure in global production owing to heavily intensive, technological complexity. Indeed it is more apt to use "technology-intensive" value chains. The technology intensive and research and development driven character of the automotive chain is evident in the trajectory of continuously accelerating production and the constant search for new materials (Barnes & Morris 2008:34)

3.4.5.2 Infrastructural challenges

The South African automotive industry faces infrastructural challenges. Importing and transporting parts to assembly plants as well as transporting and exporting finished products are two critical steps in the assembly and export process. However, managing the process is a challenge. The number of containers that can be cleared through the port per hour is also too low, with the port of Cape Town coming out as the most uncompetitive among 17 ports included in a study conducted by the Automotive Industry Development Centre (AIDC) (Van der Merwe 2009). Logistics issues are affirmed by Van der Merwe (2009:1) who states that on the World Bank's Logistics Performance Index, in terms of logistics expenditure, South Africa ranked 124th out of 150 countries reviewed. This was blamed on various logistics problems such as inadequate infrastructure, rising fuel costs and increased road freight volumes.

According to the Auto World (2010) report, infrastructure bottlenecks are causing substantial inefficiency in the motor industry pipeline and need to be addressed by the industry as a whole. There are congested ports and terminals, particularly in Durban, and insufficient "car-train'' capacity especially between Durban and Gauteng. Also, there is traffic congestion on major routes causing lengthy delays and adding to costs. Many industry leaders have suggested the need for further government incentives for the South African automotive industry and also the improvement of the transport infrastructure. The ability to transport finished products from assembly plants to ports, to clear vehicles through ports quickly and efficiently, and to ship them to their intended destinations are all crucial elements of the supply chain (Van der Merwe 2009).

3.4.5.3 Cost challenges

Cost is a major challenge in the South African automotive industry (Naude & Badenhorst-Weiss 2011:94). The South African Port Authority charges $821,6 to move one 40-foot container, in comparison with Argentina at $470, Brazil at $364, and China at $80. South Africa is not very competitive (Van der Merwe 2009). Walker (2006) asserts that new vehicles are still expensive in South Africa in relative terms. According to Walker (2006), an average South African household would need 164 weeks of earnings to buy and finance an averagely-priced new car compared to just 26 weeks in the USA, according to the McCarthy Affordability Index. Naude and Badenhorst-Weiss (2011:71) reported that on average, South Africa was 20% more expensive as a vehicle manufacturing base than Western Europe, while China was 12% less expensive than Western Europe. South Africa is therefore 30 to 40% more expensive than China and India.

Smit (2010) asserted that transport remains the main contributor to logistics costs and is thus one of the greatest challenges to the automotive industry. The freight system is heavily imbalanced towards road freight. While this means a better, more reliable and direct service, it also causes heavy road use, congestion, cost escalation and infrastructural damage, and hence, high transportation costs. According to Smit (2010), transportation costs amount to 54% of logistical costs, 14% higher than the world average. According to the Supplychainforesight report (2011), the automotive industry wished to focus on cost reduction after its demand volumes were slashed. As a result of these challenges, OEMs are putting pressure and shifting responsibilities to second-tier suppliers to hold large amounts of inventory to avoid bringing manufacturing to a halt. In Asia, manufacturers have managed to reduce costs dramatically and have thus caused concern for the continued viability of South Africa’s automotive sector (Piderit et al 2011).

Childerhouse, Hermiz, Mason-Jones, Popp & Towill (2003:142) noted that there is a high amount of inventory in the automotive supply chain, which indicates that there, appears to be little holistic thinking. Yet suppliers are constantly being driven to cut costs despite the fact it is the whole chain that supports the cost of holding products in a finished good state. In the international automotive sector, many governments are stepping in to aid their automotive industries. China and Brazil have substantially reduced their car sales taxes, while Germany has offered a car scrapping incentive of $3600 on cars nine years or older in order to encourage people to buy new cars. The USA too has introduced its own reduction in car sales taxes. There is a need for the South African government to introduce more incentives to help automotive manufacturers ride out the storm. It is particularly important to create a favourable environment for component suppliers in order to increase the percentage of local content in the make-up of vehicles manufactured (Van der Merwe 2009).

3.4.5.4 Market/service challenges

The South African automotive industry is facing the challenge of aggressively increasing and improving firm-level competitiveness and quality over the next few years (Barnes & Morris 2008:47). The key policy question, not only for South Africa, but also for other developing countries, is how to become more competitive. Auto World (2010) reported that notwithstanding all the good news for the automotive industry in South Africa, the industry is still unfortunately not renowned for world-class service. This has led to dealers and final customers sometimes cancelling their orders. If consumer satisfaction is to be attained as first priority, then the South African automotive industry will have to work even harder to provide demanding millennium customers with the level of service they expect.

The industry is also challenged by the quest for new markets. A large proportion of the vehicle models produced by major international OEMs in South Africa are also produced in China, India and Brazil. However, none of these countries would truly be South Africa's rivals in attracting automotive investment. OEMs are placing production facilities in such countries mainly to tap into their huge domestic markets (Alfaro et al 2012:9). Given economies of scale in the automotive industry, South Africa's domestic market, while significant, is not large enough for production to be economical without significant exports to outside markets. Indeed, South Africa exports a far greater proportion of its automobile production than China, India, or Brazil (Alfaro et al 2012:9). South Africa's true competitors are other medium-sized emerging market economies like Mexico, Egypt and Thailand.

Gabru (2009) contends that because of this dilemma, the South African automotive industry is being challenged by critics to diversify its markets away from reliance on the European and US markets. The markets which South Africa accesses are not determined by local manufacturers, but instead, are generally controlled centrally because of single sourcing and global planning practices of multinational manufacturers. Developing markets, predominately China, India, South America and some parts of the East, have established automotive industries that compete with South Africa as a low-cost production destination. Therefore, it is unlikely there will be much production volume moving from the East to South Africa. South Africa is becoming a high cost production destination with each year that passes, because of its higher labour rates, the rising cost and decreased availability of electricity, inefficient ports and other related challenges.

There is also too much overcapacity for South Africa to dictate or determine its own diversified market strategy. Hence it is unlikely that South Africa will be making any significant inroads into other markets in the next three to five years (Gabru 2009). While substantial manufacturing is moving offshore from Europe and the US, these products are moving to more competitive regions like China, Turkey, Brazil and Thailand, which are in a better geographical position than South Africa. Nonetheless, South Africa is better positioned to capitalise the African market (Gabru 2009).

3.4.5.5 Relationship challenges

Relationship issues are also a challenge in the South African automotive industry. In South Africa, the Broad-Based Black Economic Empowerment (BBBEE) Act 53 of 2003 was promulgated to ensure that procurement in the public and private sectors supports the economic empowerment of previously politically disadvantaged individuals through its suppliers. Government has mandated various business sectors to collaborate in developing their own sector-specific charters that outline the sector’s plans for transformation and the implementation of the BBBEE Act (Pillay & Phillips 2009:30). One of the measures in the Act has particular implications for relationships in supply chain management.

The Act requires that organisations (including OEMs) must target and purchase their supplies from previously disadvantaged organisations and use their economic power to force their suppliers to buy from previously disadvantaged suppliers. It also requires active engagement in transformation of organisations to include black individuals at all levels. The government uses a “balanced scorecard” to determine progress made in achieving BBBEE by businesses and sectors (Republic of South Africa 2003). However, it has been difficult to comply and cope with BBBEE targets (Alfaro et al 2012:24).

Another part of this challenge is collaboration with strategic partners. According to SCIR (2009), the majority of companies in the South African automotive industry not only operate with low levels of collaboration, but they are also not very sensitive or reactive to changing markets. In a survey conducted by SCIR in 2009, only 53,6% of the respondents acknowledged a reasonable level of collaboration on cost with suppliers. Collaborating with customers on cost was even lower, which is a concern for the industry.

3.4.5.6 Production/skills challenges

The South African government, realising the weak competitive position of the South African automotive industry, has put pressure on OEMs to improve their local content to 70% (through the Automotive Production and Development Programme), in order to negate the costs of importing components using long supply chains and weathering a fluctuating currency (Venter 2008; Mphahlwa 2008:2). Barnes and Morris (2008:34) assert that despite being massive scale manufacturers, General Motors, Ford, Volkswagen and DaimlerChrysler, have shown poor financial performance largely because of consistently high production overcapacity (between 25 to 30%) over the last ten years.

Availability of skills is an impediment to supply chain practices in South Africa. Skills are a major constraint on research and development, particularly the national shortage of qualified engineers. According to Alfaro et al (2012:21), there is a decline in research and development intensity among assemblers and component manufacturers. Even though the South African automotive industry has grown, its knowledge-generation capabilities have stagnated, and it is in danger of becoming a production centre with a decreasing proportion of knowledge-intensive activities (Alfaro et al 2012:21). Top priorities for the automotive industry are raising labour productivity and skill levels and deepening the automotive value chain through greater local supply of components, particularly advanced and high value-added first-tier components (Alfaro et al 2012:21). Availability of skills in the workforce and the time it takes to resolve labour disputes are thus critical issues that need attention. Labour problems seem to plague the automotive industry. Table 3.7 summarises the challenges of supply chain in the South African automotive industry.

Table 3.7: Summary of the challenges of supply chain in the South African automotive industry

Category of challenge	Description
Technological challenges	Inadequate information systems
	Inefficient planning and forecasting tool
	High cost when replacing obsolete assembly/manufacturing tools
Infrastructural challenges	Unsustainable infrastructure
	Rail transport is unreliable
	Rail capacity problems
	Increased road freight volumes
	Challenged by delays at ports
Cost challenges	High fuel costs
	High operating costs
	High cost at South African ports
	High prices of materials/components resulting in high operating costs
Market/service challenges	Difficulty finding new markets
	Sometimes customers cancel their order
	Challenges to improving service levels
Relationships challenges	Difficult to verify BEE status (scorecards) of strategic suppliers
	Difficult to collaborate with strategic suppliers
	Difficult to collaborate with strategic customers
	Operate with a low level of collaboration
Skills challenges	Unreliable production schedules
	Challenged by a lack of capacity
	Challenged by lack of skills
	Challenged by labour problems

Source: Researcher's own construction

3.5 INDICATORS FOR OPTIMISING AUTOMOTIVE SUPPLY CHAIN PERFORMANCE

Organisations need to monitor and control their operations on a daily basis to get the performance desired from their supply chains (Hugos 2006:133). Performance measurement provides the necessary assistance for optimising supply chain excellence (Chan & Qi 2003:635). One of the keys to improving supply chain performance is to have sound performance indicators in place for monitoring (Taylor 2004:173). Performance measurement supports SCM and provides useful information on long-term decisions (Wang, Heng & Chau *2007:333*). It effectively links supply chain partners to achieve breakthrough performance in satisfying end customer needs (Wisner et al 2008:486). Measurement systems therefore have to provide feedback regarding customers' needs and the supply chain's capabilities. Measurement of SCM creates an understanding of the supply chain's processes and guides collaboration efforts (Fawcett et al 2007:409). It facilitates understanding and integration between supply chain members.

3.5.1 Supply chain performance indicators

Numerous performance indicators can be used to evaluate supply chain performance and identify improvements to the design and operation of supply chains (Evans & Collier 2007:363). However, unless the right indicators are established to support the organisation's strategy, the supply chain may be poorly designed and managed (Raturi & Evans 2005:203). The manner in which supply chain performance indicators are incorporated into supply chain design plays a vital role in determining the effectiveness of the supply chain (Taylor 2004:173). Distinctions between performance indicators can be made at three levels which include the following: the supply chain level (eg product availability, quality, responsiveness, delivery reliability and total supply chain costs); the organisation level (eg inventory level, throughput time, responsiveness, delivery reliability and total organisational costs); and the process level (eg responsiveness, throughput time, process yield and process costs).

Sezen (2008) asserts that to improve supply chain efficiency and effectiveness, four criteria can be used and these include profit; lead-time performance; delivery promptness; and waste elimination (Fawcett et al 2007:421). Supply chains should therefore be evaluated on the basis of their ability to respond to any changes in products, delivery times, volume and mix (Sezen 2008:233). Flexibility measures include new product flexibility, delivery flexibility, mix flexibility and volume flexibility. Resource measures are concerned with the efficiency in using the resources in a supply chain system. Resource measures include the costs of using several resources, inventory levels in the supply chain, and the return on investments. Output measures include customer satisfaction (in terms of on-time deliveries, order fill rate, and response times), sales quantities and profit (Sezen 2008:234). This study incorporates various views on performance measurement and discusses ten performance indicators that impact on the automotive supply chain as discussed below.

3.5.1.1 Costs

Focusing on an individual organisation's costs may lead to sub-optimisation and attempts by one organisation to shift costs to another. The aim should be to reduce total costs across the entire supply chain and to share these cost reductions between the supply chain members (Bowersox et al 2010:392). Supply chain costs include all costs associated with operating the supply chain including the cost of goods and total supply chain management cost (Bolstorff & Rosenbaum 2003:52). They include supply chain costs associated with forecasting, administration, transportation, inventory, manufacturing, customer service and supplier relationship management (Burt et al 2010:308).

Total supply chain cost thus includes the total cost of managing orders, acquiring materials, managing and holding inventory and managing supply chain finances and planning and information systems (Cohen & Rousell 2005:56; Wisner et al 2008:490). As these costs include the total cost of acquisition, ownerships and use (Hugo et al 2004:12), they are always a concern for organisations, even if they compete primarily in some other performance area (Bozarth & Handfield 2006:30). Because cost performance is critical, it is tracked more carefully and comprehensively than any aspect of competitive performance (Fawcett et al 2007:412). Automotive suppliers realise that cost control and cost reduction capabilities must be intrinsic to their structure, processes, culture, and technology foundation if they are to survive and thrive.

3.5.1.2 Quality

Quality is conformance to requirement or fitness for use. According to Hugo et al (2004:165), managing product quality in supply chain is the shared responsibility of all participants. Managing quality in the supply chain is the integration of the quality philosophy of the supplier quality system, the internal system of the vantage point firm and the quality of the customer. Some of the indicators of quality include a formal quality assurance system; continuous improvement; statistical process control; six sigma limits; fail-safe lot traceability, and incoming quality assured (Hugo et al 2004:166). Jacobs et al (2009:210) assert that the quality of a specification of a product relates to decisions and actions made relative to the design and quality of conformance to the design. A firm designs a product or service with certain performance characteristics and features based on what the intended market expects. Material and manufacturing process attributes can have a huge impact on the reliability and durability of a product. According to Jacobs et al (2009:310), adherence to the quality of the design and conformance ensures that the product meets customers' objectives. This is often termed "fitness for use" and its entails identifying the dimensions of the product that the customer wants and developing a quality control programme to ensure that the dimensions are met.

To ensure quality, automotive manufacturers are now reducing the number of sole suppliers and reducing contact with second tier suppliers. The availability of many firms from which direct suppliers can choose, has allowed them to sustain the pressures that final assemblers were putting on them, relative to price reduction and just-in-time deliveries. This advantage is overridden by the need for own suppliers having to ensure high input quality, at the same time being capable of playing an increasingly autonomous role in product design and engineering. This indicates the fact that quality is a crucial requirement for vehicle manufacturers. As indicated by Godlevskaja, Van Iwaarden and Van der Wiele (2011:66), automotive manufacturers are paying attention to quality issues and reducing the number of defects in vehicles.

3.5.1.3 Flexibility

Flexibility in the supply chain is its agility in responding to random changes in the marketplace in order to gain or maintain competitive advantage (Wisner et al 2012a:451). Flexibility is thus a performance dimension that considers how quickly automotive manufacturers can respond to the unique needs of customers (Jonsson 2008:89). Flexibility has become particularly valuable in new product development. Some organisations compete by developing new products faster than their competitors. This requires supply chain partners who are flexible and willing to work closely with designers, engineers, and marketing personnel (Bozarth & Handfield 2006:30). Supply chain response time and production flexibility are two indicators for flexibility (Cohen & Rousell 2005:208). Supply chain response time measures the number of days it takes a supply chain to respond to marketplace changes without cost penalties (Bowersox et al 2010:392). Production flexibility therefore measures the number of days to achieve an unplanned increase or decrease in orders without cost penalties (Bolstorff & Rosenbaum 2003:51). Hence it is the ability of automotive manufacturers to react quickly to unexpected demand spikes while still operating within financial targets, which provides tremendous competitive advantage (Wisner et al 2008:490).

3.5.1.4 Supplier reliability

By evaluating supplier performance, organisations hope to identify suppliers with exceptional performance or developmental needs, improve supplier communication, reduce risk and manage the partnership based on an analysis (Wisner et al 2012a:78). According to Wisner et al (2012a:457) reliability of suppliers is one of the most important quality dimensions.

Some of the key indicators of supplier reliability include: billing accuracy; order accuracy; on-time completion; and promises kept.

3.5.1.5 Innovation

Innovation in the supply chain ensures that existing technologies, as well as technologies under development, always face the possibility of being pushed aside by alternative developments. In order to assess the technological and market potential of a given technology, its respective car module must be analysed in terms of the key technologies being used, current trends and future innovations. Innovation involves research and development and originates mostly with suppliers. Most innovations begin as optional equipment in new cars. Some of the performance measures and indicators for innovation include the following: annual investment in research and development, the percentage of automated processes, the number of new product or service introductions, and the number of process steps required per product (Wisner et al 2012a:514).

3.5.1.6 Responsiveness

Supply chain responsiveness refers to how quickly a supply chain delivers products to the customer (Cohen & Rousell 2005:208). It involves the time that elapses from a customer order being received to completed delivery (Jonsson 2008:88). Order fulfilment lead time is therefore an important measure for supply chain responsiveness and measures the number of days from order receipt in customer service to delivery receipt at the customer's dock (Bolstorff & Rosenbaum 2003:51). Taylor (2004:178) mentions that lead time variability should also be considered. Organisations may have short average lead times, but these lead times may vary considerably. In some cases it may be better for organisations to have longer but less variable lead times.

3.5.1.7 Order delivery lead time

According to Wisner et al (2012a:517), order delivery lead time encompasses the fulfilment of the average percentage of orders among supply chain members that arrive on time, complete and damage-free to satisfy customer requirements. Order lead time is an important and significant source of competitive advantage for top-performing supply chains and their member companies. Handfield et al (2011:746) note that order delivery as a performance measure indicates the degree to which a product was ordered to when it is delivered on time and meets customer schedule requirements. The key indicators are due dates, scheduled or promised and delivery windows. According to Handfield et al (2011:746), this measure should identify total cycle time and its key components. Measures should focus on reduction through elimination of delays and delivering continuous improvement on target times.

3.5.1.8 Final product delivery reliability

Supply chain delivery reliability refers to the performance of the supply chain in delivering the correct product to the correct place at the correct time in the correct condition and packaging in the correct quantity with the correct documentation, to the correct customer (Cohen & Rousell 2005:208). Reliability generally refers to the ability to deliver products when promised (Wang et al 2007:149). An organisation can have long lead times, yet still maintain a high level of reliability (Bozarth & Handfield 2006:28). Three indicators identified to measure supply chain delivery reliability are delivery performance, fill rates and perfect order fulfilment. Delivery performance measures the average percentage of orders delivered on time according to customers' requests (Wisner et al 2012a:490). Delivery performance measures the degree to which deliveries take place at the times agreed with the customer. It can be defined as the number of deliveries made on time in relation to the number of deliveries made (Jonsson 2008:86). In top-performing supply chains, delivery dates are met from 94 to 100% of the time. For average organisations, delivery performance is approximately 70 to 80% (Wisner et al 2012a:491).

3.5.1.9 Product variety

According to Wisner et al (2012b:58), product variety measures the number of product families processed in a facility. Processing costs and flow times are likely to increase with product variety. The range of products offered by automotive manufacturers has shown significant growth in recent years. Besides existing vehicle segments like small car, lower medium car and so on, many automotive manufacturers now offer niche products. Owing to the "law of variety" (satisfied customers changing brand because of variety attractiveness), many automotive manufacturers have extended their product range to retain clients, whereas the number of variants per car model grows as well. This impacts on the complexity of service offers, as well as complexity of service operations, for example, car maintenance and repair (Godlevskaja et al 2011:66).

3.5.1.10 Asset management

Supply chain asset management refers to the effectiveness of an organisation in managing assets to support demand satisfaction (Taylor 2004:184). This includes the management of all assets (Bolstorff & Rosenbaum 2003:52). Three indicators that measure supply chain asset management efficiency are cash-to-cash cycle times, inventory days of supply and asset turns. Cash-to-cash cycle times measure the number of days the cash is tied up as working capital. They are the average number of days between paying for raw materials and receiving payment for the product by the members of the supply chain (Wisner et al 2012a:490). Cash-to-cash cycle times typically run about 70 to 90 days, but efficient organisations reduce this number below 60 days (Taylor 2004:176). Top organisations have a cash-to-cash cycle time of approximately 30 days (Wisner et al. 2012a:490). Inventory days of supply measure the number of days the cash is tied up in inventory. Asset turns are calculated by dividing revenue by total assets, including both working capital and fixed assets (Bolstorff & Rosenbaum 2003:52).

3.6 CHAPTER SUMMARY

Chapter 3 discussed the global automotive industry, the South African automotive industry and automotive manufacturing supply chain practices and challenges. The automotive industry is driven by competitiveness and innovation that forces industry manufacturers and their suppliers to continuously adapt to changes in the marketplace. In South Africa, the industry is leading the practice of SCM in the country and is a major contributor to GDP and employment creation. However, the industry faces supply chain challenges that hinder its performance and prevent it from becoming a significant global player in the industry. This indicates the need to employ or design a supply chain strategy that would be responsive to the changing needs of the customer. Such strategies will be discussed in the next chapter (chapter 4).

CHAPTER 4

SUPPLY CHAIN MANAGEMENT STRATEGIES

4.1 INTRODUCTION

Chapter 3 discussed the global and South African automotive industry and examined the challenges, trends and development of supply chains. Chapter 4 deals with supply chain strategies and designs. In this chapter, the supply chain strategy will be defined, the manufacturing environment reviewed and the various types of supply chain strategies and their characteristics discussed. The chapter will thus explore the different types of strategies and combinations of strategies that exist.

4.2 SUPPLY CHAIN STRATEGY

A supply chain strategy is part of the overall business strategy, designed around a well-defined basis of competition (Innovation, low cost, service and quality) (Hugo et al 2004:22). This strategy is integrated with marketing strategy and with customers' needs, product strategy and the company’s power position. In a rapidly evolving global economy, no firm exists in a vacuum (Hugo et al 2004:22). Organisations are under pressure to optimise their resources to manufacture products better, cheaper and faster with lower costs. The pace of innovation in domestic and global industries has been accompanied by an increase in product variety, sophistication and quality and a decrease in costs (Hines 2006:33).

4.2.1 Defining supply chain strategy

Owing to an awareness of the need to align processes with trading partners to achieve business outcomes, business competition has shifted from a traditional firm basis to a supply chain-wide basis (Hugo et al 2004:22; Lo & Power 2010:140). A supply chain strategy is part of the overall business strategy, designed around a well-defined basis of competition (innovation, low cost, service and quality) (Cohen & Rousell 2005:10). Supply chain strategy utilises interfirm coordination as the capability that facilitates achievement of objectives focused on revenue growth, operating cost reduction, working capital and fixed capital efficiency in order to maximise shareholder value (Defee & Stank 2005:33). It is integrated with marketing strategy and customers' needs, product strategy and power position. In a rapidly evolving global economy, no firm exists in a vacuum (Hugo et al 2004:22).

Supply chain strategies are pivotal to the success of most contemporary business organisations and equally important for not-for-profit organisations (Hines 2006:32). It is important to recognise that supply chain strategies exist whether or not they are planned. In other words, all organisations *de facto* have a strategy. An organisation making an operational decision to procure materials may not be conscious of determining a supply chain strategy but that decision taken *ex ante* may have longer-term consequences both for the purchaser and supplier. An organisation's supply chain design or supply chain strategy must be in alignment with its competitive strategy (Chopra & Meindl 2010:37). A supply chain design can be taken up only after the competitive strategy has been finalised and the chain needs to be redesigned or modified whenever there is a change in competitive strategy. A supply chain strategy includes supplier strategy, operations strategy and logistics strategy. Design decisions regarding inventory, transportation, operating facilities and information flows in the supply chain of a company are all part of the supply chain strategy (Cohen & Rousell 2005:20). Table 4.1 below shows the contribution of the supply chain strategy to business strategy.

Table 4.1: Supply chain contribution to business strategy

Primary (contributor)	**Source of advantage**	**Basis of competition**	**Key supply chain strategy**
Innovation	Brand and unique technology	Desirable and innovative products	Time to market and time to volume
Cost	Cost efficient operations	Lowest prices in the product category	Efficient low cost infrastructure
Service	Superb service	Tailored to meet customer-specific needs	Designed "from the customer in"
Quality	Safest, most reliable products	Products you can count on	Supply chain excellence and quality control

Source: Cohen & Rousell (2005:22)

4.3 A REVIEW OF THE MANUFACTURING ENVIRONMENT

The unique nature of manufacturing processes and customer requirements limits the practical range of manufacturing strategies (Cohen & Rousell, 2005:12; Bowersox et al 2010:86). The range of manufacturing strategies is constrained by both marketing and technological forces. Prevailing marketing practices serve to crown manufacturing strategies in terms of customer acceptability. Technology drives strategy to a manufacturing model that is competitive. According to Kazan, Ozer and Cetin (2006:14), a manufacturing strategy can be defined as a set of coordinated objectives and action programmes applied to a firm's manufacturing function and aimed at securing medium- to long-term sustainable advantages over that firm's competitors. This strategy is considered for identification of organisational design specifications that lead to organisational design (Gouvea da Costas & Pinheiro de Lima 2009:74).

4.3.1 Manufacturing processes

Manufacturing processes have undergone significant changes in the past decade posing severe challenges to the way manufacturing is perceived and practiced (Riis, Johansen, Waehrens & Englyst 2007:934). A manufacturing process can be defined as the use of machine tools and labour to make things for use or sale (Riis et al 2007:934). According to Karlsson and Skold (2007:912), a manufacturing process is a discipline with few alignments with business strategy and firm positioning. In order to accomplish and sustain competitiveness in the world market, manufacturing companies must produce quality and low-cost products with increasing variety, over shorter lead times (Kazan et al 2006:14). Different manufacturing processes provide different capabilities (Bowersox et al 2010:86). There are four common types of manufacturing structures in a manufacturing environment. These structures include the job shop, batch process, line flow process and continuous improvement (Bowersox et al 2010:86) and they are discussed below.

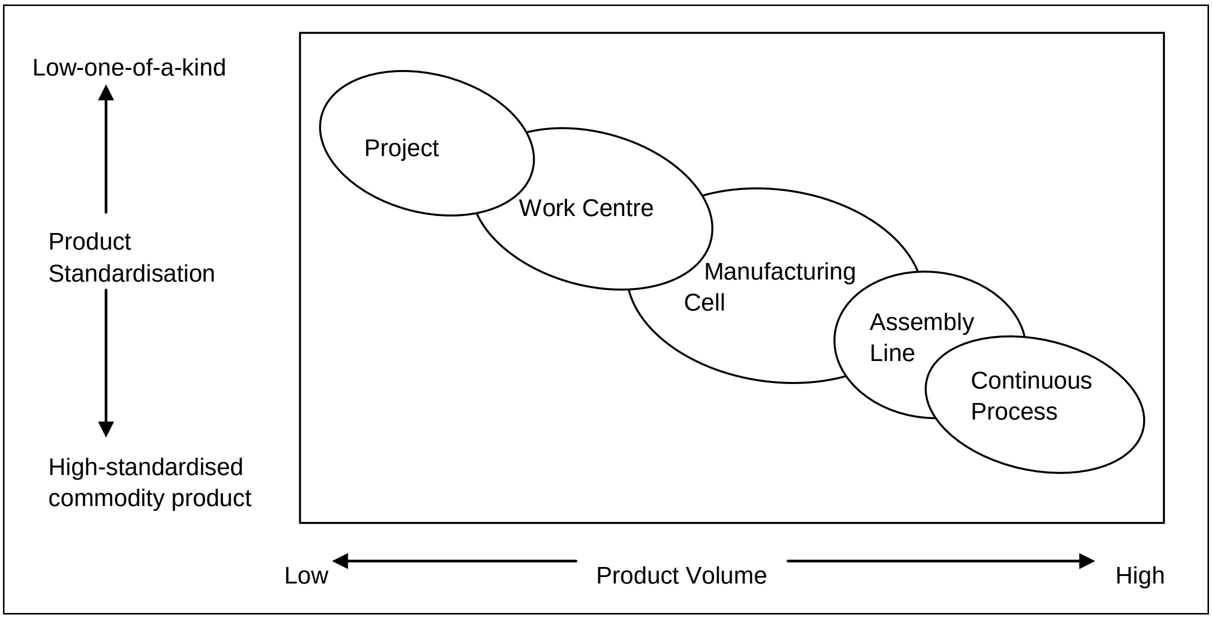
- **Job shop process.** Job shop products are typically customised for a specific customer (Bowersox et al 2010:86). In this process, each order or "job" can involve different materials and inputs. Jacobs et al (2009:206) refer to this process as "a work centre" where similar equipment or functions are grouped together. An example of this process includes a tailor who makes customised suits and other clothes for consumers.
- **A batch process.** A batch process is used to manufacture a small quantity item in a single production run before changing over to produce another item. Jacobs et al

(2009:206) term this process the “manufacturing cell”. This is a dedicated area in which products that have similar processing requirements are produced.

- **Line flow process.** This process is typical used in the manufacturing environment. As noted by Bowersox et al (2010:86), in line processes, products with a similar number of variations are typically used on assembly lines through various stages of production where processes or components are added at each stage. According to Jacobs et al (2009:206), the path for each product is in effect a straight line. Discrete parts are made by moving from workstation to workstation at a controlled rate following the sequence needed to build the product. Examples include the assembly of toys, appliances and automobiles.
- **A continuous process.** This process is unsuitable for manufacturing discrete products (Jacobs et al 2009:206). It is similar to the assembly line (line flow) in that the product follows a predetermined sequence of steps, but the flow is continuous. Such structures are usually highly automated and in effect, constitute one integrated “machine” that may be operated for 24 hours a day to avoid expensive shut-downs and start-ups. Bowersox et al (2010:87) maintain that these processes offer little variety and are often referred to as commodities. Examples include gasoline, laundry detergent and aluminium.

The relationship between layout structures is often depicted on a product-process matrix (Jacobs et al 2009:207). The format used to arrange facilities begins with the project. In the project layout, the product remains in a fixed location. Two dimensions are used to illustrate this matrix. As indicated in figure 4.1, the first dimension relates to the volume of the product produced. Standardisation is shown on the vertical axis and refers to variation in the product. These variations are measured in terms of geometric differences, material differences and so on. Standardised products are highly similar from a manufacturing processing point of view, whereas low standard products require different processes. Figure 4.1 depicts the product-process matrix describing the layout of manufacturing strategies.

Figure 4.1: Product-process matrix: framework describing layout strategies



Source: Jacobs et al (2009:207)

Owing to advanced manufacturing technologies in today's business environment, some layout structures span relatively large areas of the product process-matrix (Jacobs et al 2009:206). As noted by Hines (2006:132), organisations that operate on projects and jobs require different sources of competitive advantage built on achieving economies of scope.

4.3.2 Manufacturing strategies

Typical techniques in marketing strategies are classified as being mass, sequential and focused or one-on-one (Bowersox et al 2010:87). These strategies are differentiated in parts, in terms of the deserved degree of product and service accommodated. One-on-one marketing strategy is built on unique or customised product/service offerings for each and every customer. A firm strategic marketing position regarding flexibility and agility to accommodate specific customer requirements is directly related to manufacturing capability. For a firm to effectively compete, it must be able to integrate manufacturing capability into a meaningful marketing value proposition. The most common manufacturing strategies are make-to-stock, make-to-order, configure-to-order and engineer-to-order (Taylor 2004:28; Cohen & Rousell 2005:12; Shapiro 2007:325; Webster 2008:218; Bowersox et al 2010:87).

4.3.2.1 Make-to-stock

This is the best strategy for standardised products that sell in high volumes (Cohen & Rousell, 2005:11). Larger production batches keep manufacturing costs down, and having these products in inventory means customer demand can be met quickly. In the make-to-order strategy, a supplier makes products in advance of demand and holds them in finished goods inventory, satisfying demand from that inventory as orders come in (Taylor 2004:28). The strategy produces standard products (Shapiro 2007:325). It is also commonly known as make-to-plan (Jacobs et al 2009:87). This strategy is characteristic of industries exploiting economies of scale gained from long production runs.

4.3.2.2 Make-to-order

According to Cohen and Rousell (2005:11), make-to-order is the preferred strategy for customised products or products with infrequent demand (Shapiro 2007:325). Companies following this strategy produce a shippable product only with a customer order in hand. This strategy may not be as limited as the traditional job shop, but exact quantities and configurations are produced in relatively small quantities (Bowersox et al 2010:87). In the make-to-order strategy, the supplier does not build a product until it has an order in hand (Taylor 2004:28; Webster 2008:219).

4.3.2.3 Configure-to-order

This is a hybrid strategy in which a product is partially completed to a generic level and then finish when an order is received (Cohen & Rousell 2005:11). This is the preferred strategy when there are many variations of the end product and the supplier wants to achieve low-finished goods inventory and shorter customer lead time than make-to-order can deliver. Taylor (2004:28), Webster, (2008:219) and Bowersox et al (2010:87) call this strategy "assemble-to-order" (ATO). The attractiveness of a configure-to-order (assemble-to-order) manufacturing strategy is that it has the potential to combine some facets of economies of scale typical of make-to-plan with a degree of the characteristics of make-to-order (Bowersox et al 2010:88).

4.3.2.4 Engineer-to-order

This manufacturing strategy shares many of the characteristics of make-to-order (Cohen & Rousell, 2005:11). The strategy is used in industries where complex products and services are created for unique customer specifications. As noted by Webster (2008:218), engineer-to-order is quite distinct from the other three categories. An engineer-to-order product is designed, developed and produced in response to a customer request.

Manufacturing strategies clearly have a significant impact on the lead times experienced by customers. The choice of make-to-order, configure-to-order or make-to-stock determines whether a customer will bear the cost of the waiting for completion of one or more products (Bowersox et al 2010:88). Table 4.2 shows the various manufacturing strategies, when to choose a strategy and the benefits of each.

Table 4.2: Types of manufacturing strategy

Strategy	When to choose this strategy	Benefits
Make to stock	For standardized high volume products	Low manufacturing cost, meeting customer demands quickly
Configure to order	For products requiring many variations	Customization, reduced inventory, improved service levels
Make to order	For customized products with infrequent demand	Low inventory levels, wide range of product options, simplified planning
Engineer to order	For complex products that meet unique customer needs	Enables response to specific customer requirements

Source: Cohen & Rousell (2005:12)

Changing manufacturing strategies can be a source of performance advantage in an organisation (Cohen & Rousell, 2005:11). According to Taylor (2004:28), some companies use a mix of the manufacturing techniques, but they choose one as their primary strategy. The choice of manufacturing strategy has a major impact on the dynamics of the supply chain. Bowersox et al (2010:88) claim that each manufacturing process is associated with product variety and volume generally produced, as well as the strategy generally employed and the resulting impact on customers in terms of expected total lead times. Table 4.3 shows the characteristics of the manufacturing process in terms of product variety, volume, strategy and customer lead times.

Table 4.3: Characteristics of manufacturing processes

	Product variety	Volume	Strategy	Customer lead-time
Job shop	Very high	Very low	MTO	Very long
Batch	High	Low	MTO/ATO	Long
Line flow	Limited	High	ATO/MTS	Short
Continuous flow	Very limited	Very high	MTS	Very short

Source: Bowersox et al (2010:89)

As indicated in table 4.3, MTO strategies typically require significant component inventory and may result in high-cost customer accommodation. In the light of the trade-offs, the design of a supply chain system should be based on the total manufacturing cost (Bowersox et al 2010:87). As noted by Gunasekaran and Ngai (2005:424), diverse customer tastes and preferences and rapid developments in technology pose major challenges for manufacturers. Today, mass customisation has become a major objective for many fortune companies. Bowersox et al (2010:87) note that standardised parts, using modular designs and postponing product differentiation are practices used with mass customisation.

4.4 TYPES OF SUPPLY CHAIN STRATEGY

The major generic strategies in supply chain are leanness and agility (Hull 2005; Simons & Zokaei 2005; Hallgren & Olhager 2009: Vinodh et al 2009; Pandey & Garg 2009). "*Leanness* means developing a value stream to eliminate all waste including time, and to enable a level schedule" whereas "[a]*gility* means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace" (Mason-Jones 2000:4046).

4.4.1 Lean supply chain strategy

In this subsection the definition, background and characteristics of a lean supply chain and the benefits of lean supply-chain strategies will be discussed.

4.4.1.1 Definition of and background on leanness

The term "lean" means a series of activities or solutions to eliminate waste, reduce non-value-added (NVA) operations and improve value added (Wee & Wu 2009:336). Rahimnia, Maghadisian and Castka (2009:801) define leanness as "developing a value stream to eliminate all waste, including time and to ensure a level schedule". Leanness is a systematic approach to identifying and eliminating waste (non-value-added activities). As stated by Castle and Harvey (2009:280), in order to meet customer's needs, an organisation must identify what customers think of waste. Elimination of waste and ensuring value is the core objective of leanness. Petterson (2009:127) advocated that there is no clear definition of lean. Hines, Holweg and Rich (2004:994) and Kollberg, Dahlgaard and Brehmer (2007:9) state that the idea of lean production was born in the 1950s and did not reach readers outside Japan until the 1990s. The term does not have a clear and concise definition.

According to Simons and Zakaei (2005:193), Comm and Mathaisel (2005:135) and Salman, Van der Krogt, Little and Geraghty (2007:2), in Western communities, the term was introduced through the book, *The machine that changed the world: the story of lean production* (Womack et al 1990). The book documents the evolution of the automotive industry from craft production, to mass production and ultimately to lean production. The concept of leanness is associated with Henry Ford in the 1920s, when he applied the concept of "continuous flow" to the assembly line process. The practice focused on reduction by improving quality and throughput. The aim was to bridge the gap in performance between Toyota and Western car makers using mass production systems (Kollberg et al 2007:9). The concept was further elaborated upon in Womack and Jones's (2003) book, *Lean thinking: banish waste and create wealth in our corporation*. The concept extended from the shop floor to include the entire organisation, not only the manufacturing function (Kollberg et al 2007:9). Hines et al (2004:995) termed this process "extension" to include a new design based on lean principles. As noted by Papadopoulou and Ozbayrak (2005:785) the origin of leanness is associated with two concepts: Toyota production systems (TPSs) and the just-in-time (JIT) philosophy.

Piercy and Rich (2009:58) advocated that the fierce competition imposed by mass production systems during and after the World War II era led the Toyota Motor Company (TMC) to a thorough study of the production system of the US automobile industry and in particular Ford (the Ford Production System – FPS) (Hines et al 2004:994). The solution offered by Toyota led to a complete reconstruction of the company and soon gave way to the introduction of an alternative production system referred to as the TPS, which was aimed at directly attacking any form of waste in the production process. Salman et al (2007:2) describe TPS as comprising two main concepts: “Cost reduction through the elimination of waste”; and “Full utilization of workers’ capabilities”. Cost reduction is primarily achieved through the use of JIT production, while TPS achieves full utilisation of workers capabilities by promoting respect for individuals through minimising employee movements, emphasising employee safety, valuing and encouraging employee involvement and increasing employee responsibilities.

As noted by Papadopoulou and Ozbayrak (2005:786), the JIT philosophy was developed in the framework of this new production system and evolved exactly out of the need of the Japanese industry to survive in the post-war global market. JIT is perhaps the most fundamental element of TPS (Simons & Zokaei 2005:193). The introduction of the JIT concept soon led to the development of a number of other complementary elements such as small lot production, set-up time reduction, the Kanban system and so on. These elements soon became “inseparable” parts of the JIT system, a fact that possibly led to the perception of the JIT system in “its totality” as a complete manufacturing philosophy. Lean manufacturing is regarded as a manufacturing philosophy, which, if adopted and carefully implemented, can undoubtedly form the roadmap to global manufacturing (Piercy & Rich 2009:55). Lean means “manufacturing without waste”. According to Taj (2008:629), lean manufacturing is much more than a technique. It is a way of thinking and a whole system approach that creates a common culture in an organisation. The lean approach is focused on systematically reducing waste (Muda) in the value system.

4.4.1.2 Characteristics of a lean supply chain

Piercy and Rich (2009:56) note that the basic idea of leanness is attractively simple: organisations should be obsessively focused on the most effective means of producing value for their customers. An organisation using leanness will approach this challenge by using five basic lean principles; focusing on understanding waste and value in its work; and training staff who do and manage the work to act as improvement teams to effect change. According to Hofacker (2007:27) and Julien and Tjahjono (2009:324), these principles can be explained as follows:

- **Specify customer value.** Value is the only thing the customer wants, and this therefore requires a precise understanding of the customer’s specific needs.

- **Understand the value stream.** Value streams are those activities that, when done correctly and in the right order, produce the product or service the customer values. A lean organisation traces and manages all the activities in the organisation that deliver value wherever they are and whichever department they are in.
- **Improve the flow.** Lean organisations make the value flow and never delay a value-adding activity. A lean organisation's work should flow steadily and without interruption from one value-adding or supporting activity to the next. This is in contrast to the "batching" of work where, for instance, a week's expense claims are collected for a manager to authorise in one go.
- **Pull.** Lean organisations only make what is required by the customer. The system should react to customer demand - in other words, customers *pull* the work through the system. In non-lean organisations, work is *pushed* through the system at the convenience of operators, thus producing outputs that are not required.
- **Perfection.** A lean organisation continuously improves the system by reducing waste. As the first four principles are implemented, understanding of the system becomes clearer, and from this understanding ideas for more improvement are generated. A lean system becomes even leaner and faster and it becomes easier to identify and eliminate waste. A perfect process delivers just the right amount of value to the customer. In a perfect process, every step adds value and improves capability (produces a good result every time), availability (produces the desired output, not just the desired quality, every time), adequacy (does not cause delay), flexibility (process adapts automatically) and continuity (whole process is linked by continuous flow).

4.4.1.3 Leanness as a supply chain strategy

A lean supply chain is a strategy that produces just what and how much is needed, when it is needed and where it is needed. Leanness is a supply chain term defined as the "enhancement of value by the elimination of waste" (Womack & Jones 2003). The primary objective of a lean supply chain can be realised by using the most basic forms of data communication on inventories, capacities and delivery plans and fluctuations, according to JIT principles. The aim of integration is to ensure commitment to cost and quality, as well as achieving minimum distortion to plans, schedules and regular delivery of small volumes of orders. A lean supply chain is mainly concerned with cost reduction by operating the basic processes at minimum waste. Lean philosophy is applicable when market demand is predictable and buyers' decisions are highly dependent on the lowest price criterion. Owing to the fact that market demand is predictable, product supply is based on forecasts (Gattorna 2006:136). Customers in lean supply chains are receive value through “low production cost and logistics achieved by using all available synergies and economies of scale” (Gattorna 2006:138).

4.4.1.4 Benefits of lean supply chain systems

There are several success stories in the supply chain environment brought about through lean thinking initiatives (Rhodes, Warren & Carter 2006; Jorgensen & Emmitt 2008; Pettersen 2009; Hilletofth 2009; Kollberg et al 2007). Many organisations have successfully implemented and are benefiting from the application of lean manufacturing techniques (Gurumurthy & Kodali 2009:274). The benefits of a lean supply chain include the following:

- **Speed and responsiveness to customers.** Lean systems make a supply chain more efficient and faster. As the culture of leanness takes over the entire supply chain, all links increase their velocity. A culture of rapid response and faster decisions becomes the expectation and the norm.
- **Reduced inventories.** Many companies today produce directly into trailers and maintain no other finished goods inventory. All quality inspections and checks are performed within the process, instead of after production has been completed. Hence goods are shipped directly to the next link in the supply chain when the trailer is full, and overproduction is not possible or tolerated. No space is designated to store finished goods. The elimination of bottlenecks is one goal of a lean supply chain, but a bottleneck will always exist to some degree.
- **Reduced costs.** Lean production tries to minimise unit cost by increasing total production over the life cycle of the product. To recover the enormous development and initial capital costs sunk into the product before it was produced, mass producers forecast and run long production cycles times.
- **Improved customer satisfaction.** Leanness promotes minimising new product development time and expense. This delivers the product to market faster, making it easier to incorporate current requirements into the product. It also promotes the use of less capital-intensive machines, tools and fixtures, which results in greater flexibility and less initial cost to recover.
- **Supply chain as a competitive weapon.** A strong supply chain enables member companies to align themselves with each other and coordinate their continuous improvement efforts. This synthesis enables even small firms to participate in the results of lean efforts. Competitive advantage and leadership in the global

marketplace can only be gained by applying lean principles to the supply chain. Thought, commitment, planning, collaboration and a path forward are required.

- **Path forward to a lean supply chain.** Leanness is a cooperative process for survival and success. Supply chains that want to grow and continue to improve must adopt leanness. Lean concepts require an attitude of continuous improvement with a bias for action. The concepts of leanness apply to all elements of the supply chain, including support departments such as product development, quality, human resources, marketing, finance, purchasing and distribution. The challenge is to bring all of these areas out of their traditional silos and make them work together to reduce waste and create flow. Duplication and a lack of appropriate and timely communication run rampant in these traditional organisations. A lean supply chain is proactive and plans for the unexpected by positioning all resources for effectiveness. Downturns in demand can be addressed without layoffs or significant productivity losses.

4.4.2 Agile supply chain strategy

This subsection focuses on the definition and background on agility, agility as a supply chain strategy, elements of an agile supply chain and the framework for developing an agile supply chain.

4.4.2.1 Definition of and background on agility

The concept of agility is widely applied and adapted to the area of contemporary business (Agarwal, Shankar & Tiwari, 2007:443). According to Gunasekaran, Lai and Cheng (2008:550), the requirements for organisations and facilities to become more flexible and responsive to customers' needs lead to agile manufacturing. The origins of agility as a business concept lie in flexible manufacturing systems (Baker 2008:28; Li, Chung, Cheng, Goldsby & Holsapple 2008:401). According Christopher (2005) and Vinodh et al (2009:572), the term "agility" was first introduced as a management paradigm in 1991, when the Iacocca Institute of Lehigh University (USA), released its report "21st century manufacturing enterprise strategy: an industry-led view" (Christopher 2005; Kisperska-Moron & Swierczek 2008:2; Rahiminia et al 2009:801). Agility has been expressed in different ways and has its roots in time-based competition and fast-cycle innovation. It is built on a foundation of some, but not all of the practices common to lean thinking.

Agility has been introduced as a total integration of business components (people, technology and other organisation and business elements). As noted by Gunasekaran et al (2008:556) one of the factors contributing to agility and the increase of agile manufacturing has been the development of manufacturing support technology that allows marketers, design and production personnel to share a common database of parts and products and to share data on production capabilities and problems. It has been represented as the flexibility of the above-mentioned business components working towards a common goal (Christopher & Towill 2001). In defining agility, expressions such as concurrency, adaptability, use of information systems and technologies, flexibility and diverse combinations are taken into consideration (Iskanius 2006:93).

According to Iskanius (2006:93) as noted by Preiss (2005), agility is “a comprehensive response to the business challenges of profiting from rapidly changing, continually fragmenting, global markets for high-quality, high-performance, customer-configured goods and services. It is dynamic, context-specific, aggressively change-embracing, and growth-oriented”. The latter definition is comprehensive and accurate. Gunasekaran et al (2008) define agility as “using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market”. As stated by Pandey and Garg (2009:99), agility is a business-wide capability that embraces organisational structures, information systems, logistics processes and, in particular, mindsets. A key characteristic of an agile organisation is flexibility. Therefore agility means different things to different enterprises in different contexts. As changes and pressures faced by companies may be different, the degree of agility required by individual companies will be different and therefore agility may stem from different issues.

Hence the main objective of agility is on the basis of competition, business practice, corporate structures in the 21st century, strategic response, about adaptability, building defence against competitors, a paradigm shift, and steps towards innovation as well as holding the promise of a world based on cooperation. Agility is thus an appropriate strategy to deal with turbulence, reconfigure operations to allow individual customer specifications to be accommodated in high-volume manufacturing. According to Baker (2008:28), agility not only responds to changing market conditions, but also exploits and takes advantage of changing opportunities. Agility is extremely broad and a multidimensional concept. It involves the driving aspects of an organisation as the supply chain (Li et al 2008:410).

4.4.2.2 Agility as a supply chain strategy

The application of agility to the concept of supply chains was introduced in order to transfer and apply the winning strategy of agility to that of supply chains (Rahimnia et al 2009:801). Agility in the context of SCM focuses on "responsiveness" (Christopher & Towill 2000). According to Li et al (2008:408), in today's complex and challenging supply chain, agility is critical in global competitiveness. Kisperska-Moron and Swierczek (2008:2) state that the drivers behind the need for agility in supply chains are similar to those that drove the introduction of the agile manufacturing concept and stem from the rate of change and uncertainties in the business environment. Agility in a supply chain, according to Ismail and Sharifi (2006), is the ability of the supply chain as a whole and its members to rapidly align the network and its operations to the dynamic and turbulent requirements of customers. The main focus is on running businesses in network structures with an adequate level of agility to respond to changes as well as proactively anticipate changes and seek new emerging opportunities. It measures how well the relationships involved in the processes can be enhanced and widely accepted as a winning strategy for growth (Ismail & Sharifi 2006; Kisperska-Moron & Swierczek 2008:2). According to Gunasekaran et al (2008:550), agility should not only be based on responsiveness and flexibility, but also on the cost and quality of goods and services.

4.4.2.3 Elements of an agile supply chain

The key elements of an agile supply chain include the following (Ismail & Sharifi 2006:433; Gunasekaran et al 2008:553): *being information driven (or virtual)* (virtual supply chains are based on information rather than inventory); *market sensitivity* (*or demand-driven*) - through the capturing and transmission of point of sale data; *having integrated processes* - collaboration between buyers and suppliers, joint product development, common system design, shared information; and *being network-based* - confederations of partners linked together as opposed to "standalone" organisations. The different elements are explained as follows:

- **Virtuality.** Virtual manufacturing has been considered a crucial enabler for agility in SCM (Gunasekaran et al 2008:554). Virtual integration is measured using two practice areas. The first is internal to downstream (with customers) information integration, and the second internal to upstream (with suppliers) information integration. Several different measures can be found in order to analyse virtual integration, as highlighted below (Yusuf, Gunasekaran, Adeleye & Sivayoganathan 2004): information integration in the supply chain with customers, distributors and logistics service providers; information integration with suppliers and raw material providers; transactional internal systems; and internal planning systems. This relies on information across all supply chain partners (Ismail & Sharifi 2006:433)

- **Market sensitivity.** This is closely connected to the end-user trends (Ismail & Sharifi 2006:433). Market sensitivity is measured in terms of the product/service offerings in the market and, in particular, the amount of customisation and responsiveness to volatile and demanding markets. The following different measures can be used to analyse market sensitivity (Yusuf et al 2004): the ability to respond to demand with new product variants without overstocks and lost sales; products are customised rather than standardised; products are easy to adjust to demand rather than "take-it-or-leave-it" packages; specific customer demands are included as part of the offering as a standard practice without additional costs; and the added value of base product proposition is expanded through additional services. Market-oriented companies often segment markets and differentiate products and services to create and retain satisfied customers and overtake the competition (Yusuf et al 2004).

- **Process integration.** This has a high degree of process interconnectivity between network members (Ismail & Sharifi 2006:433). Process integration is measured both on the ability to generate and use information and market signals through processes and the ability to develop processes, products and management systems. The following measures are used to analyse process integration (Yusuf et al 2004): the ability to generate and use market information in processes; the ability to generate and use customer information in processes; the ability to develop process-innovations; the ability to develop product-innovations; and the ability to develop management-innovations. Shared information between supply chain partners can only be fully leveraged through process integration. Process integration promotes collaborative partnerships between buyers and suppliers, joint product development, common systems and shared information. This form of cooperation in the supply chain is becoming more prevalent as companies focus on managing their core competences and outsource all other activities (Christopher & Towill 2001; Yusuf et al 2004).

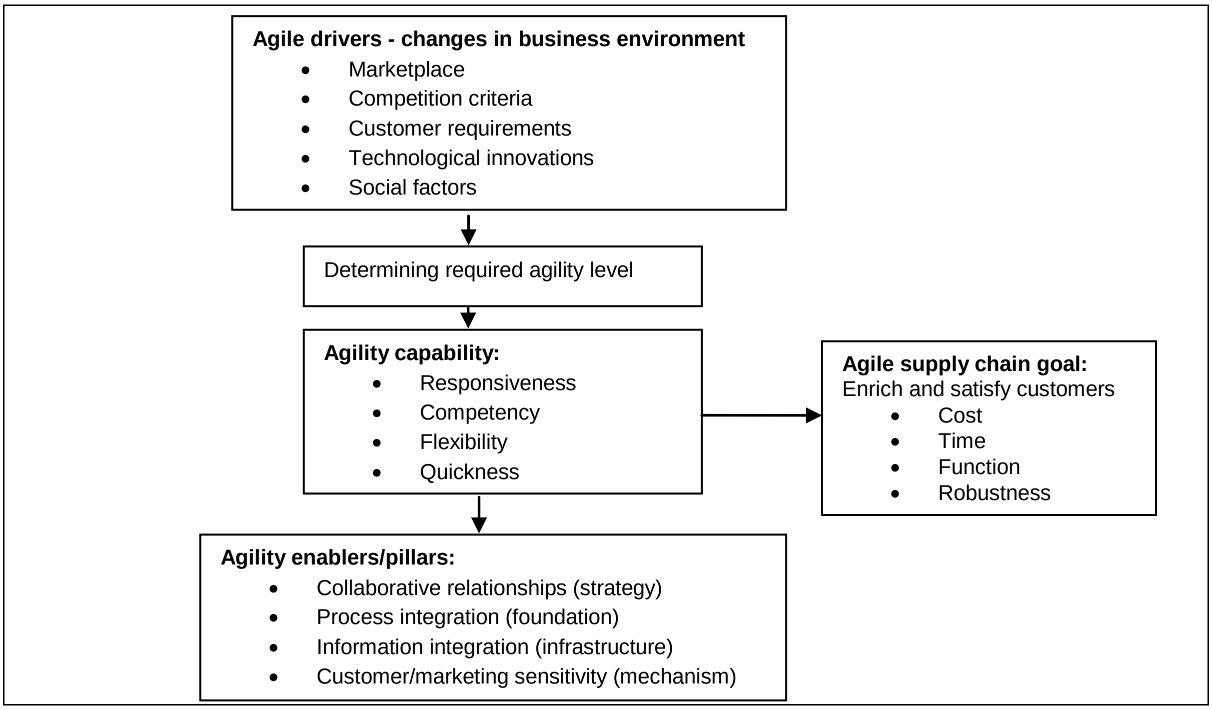
- **Networking.** A supply chain gains flexibility by using the strength of the specialist player (Ismail & Sharifi 2006:433). Network integration is measured using the structural practices and capability areas of shared investments, joint planning and strategy development in areas as broad as logistics, purchasing and production. The following measurements are applied to analyse network integration and cooperation (Yusuf et al 2004): the importance of shared investments in purchasing, logistics and production; the importance of joint planning and strategy development in purchasing, logistics and production; and the importance of close supplier relations. Process integration cannot be complete without a tight linkage of organisational relationships between companies. The success of any integration task is predicated on close collaboration inspired by a perception of mutual benefit (Yusuf et al 2004).

4.4.2.4 Framework for developing an agile supply chain

The ultimate goal of an agile supply chain is to enrich and satisfy customers. The customer satisfaction objective is illustrated in the following four paradigms: cost, time, function and robustness. The main driving force behind agility is change and agility drivers are the changes or pressures in a business environment that force a company to search for new ways of operating in order to maintain its competitive advantage (Ismail & Sharifi 2006). Change drivers are the starting point for developing an agile supply chain. They can be characterised by five elements that initiate change. These include the following: changes in the marketplace; changes in customer requirements; changes in competition criteria such as the formation of new organisations and cooperation methods; changes in technology such as new products, materials, manufacturing methods, design tools; and changes in social factors such as people's welfare and standard of living, politics, legislation (Iskanius 2006:103). Developing an agile supply chain as a result of external and environmental changes affects an organisation's willingness or need to establish processes, people, and so on, towards the benchmarking criteria. These criteria include the following: (1) market segmentation; (2) production to order in arbitrary lot sizes; (3) information capacity to treat masses of customers as individuals; (4) shrinking product lifetimes; (5) convergence of physical products and services; (6) global production networks; (7) simultaneous intercompany cooperation and competition; (8) distributed infrastructure for mass customisation; (9) corporate reorganisation; and (10) pressure to internalise prevailing social values (Iskanius 2006:103).

An agile supply chain requires various distinguishing capabilities in order to enrich and satisfy customers. These capabilities include the following four main elements: responsiveness, which is the ability to identify changes and respond to them quickly, reactively or proactively, and also to recover from them; competency, which is the ability to efficiently and effectively realise enterprise objectives; flexibility/adaptability, which is the ability to implement different processes and apply different facilities to achieve the same goals; and quickness/speed, which is the ability to complete an activity as quickly as possible. To become a truly agile supply chain, key enablers are classified into the following four categories: (1) collaborative relationship, as the supply chain strategy; (2) process integration as the foundation of the supply chain; (3) information integration as the infrastructure of the supply chain; and (4) customer/marketing sensitivity as the mechanism of the supply chain (Iskanius 2006:103). According to Waters (2007:56), change is the driving pillar of agility. The conceptual framework for agile supply chain is depicted in figure 4.2.

Figure 4.2: Conceptual framework for an agile supply chain



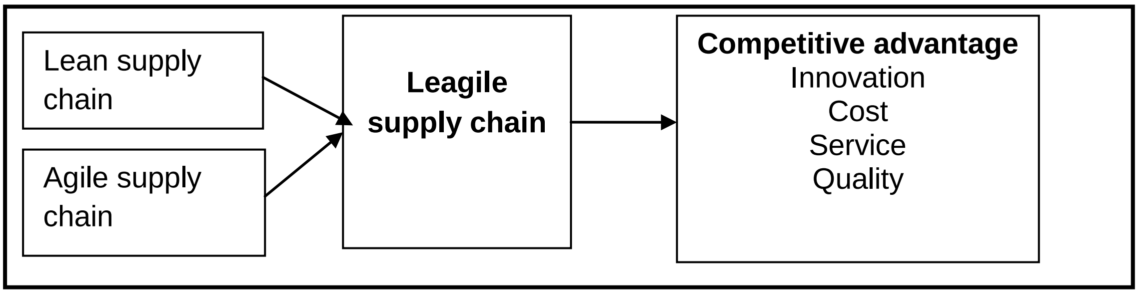
Source: Iskanius (2006:102)

4.4.3 The leagile supply chain strategy

Lean and agile supply chain strategies can be integrated (Faisal et al 2006:884; Krishnamurthy & Yauch 2007:591; Hilletofth 2009:20). They can be linked to evolve a new manufacturing paradigm under the name “leagile” (Vinodh et al 2009: 573). Krishnamurthy &

Yauch (2007: 591) define leagility as "a system in which the advantages of leanness and agility are combined". The leagile supply chain aims to infuse competitiveness into an organisation in a cost-effective manner. Leagility is the combination of lean and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream, yet providing level schedule upstream from the decoupling point (Hull 2005:230; Vinodh et al 2009:573; Rahiminia & Moghadasian 2010:81). An organisation can achieve a competitive advantage by strategically employing a leagile supply chain model by combining a lean and an agile supply chain strategy, as shown in figure 4.3.

Figure 4.3: Achieving a competitive advantage through a leagile supply chain



Source: Researchers' own construction

By employing a leagile supply chain strategy, the organisation ensures that it will minimise cost and maintain stability while being flexible and responsive to customer demand (Hull 2005:230). This leads to a competitive advantage through innovation, cost, service and quality (Mistry 2005:104; Qi, Boyer & Zhao 2009:670).

According to Vinodh et al (2009:573), the leagile supply chain was developed exclusively to enhance the performance of supply chains. Mistry (2005) studied the evolutional development of the concepts of lean and agile supply chains and developed an integrated framework for the evolution of these supply chains. Table 4.4 below indicates the transition over a 15 to 20 year period from product driven, to market-oriented, to market-driven and finally through to individual, customer-driven enterprises (Christopher & Towill 2001). During the aforementioned change, the market winner has rotated between quality, cost, availability and lead-time. But at any one point in time, the other performance metrics remain market qualifiers which cannot be prejudiced if business is to continue to be won. According to Mistry (2005:104), the integration of lean and agile supply chain is stimulated by the build-to-order system. This leads to an emphasis on the "pull" and "push" processes of the supply chain being connected by forecasts.

The transition of lean and agile to an integrated leagile supply chain can be interpreted using an integrated approach to supply chain design, in which the real focus of supply chain re-engineering is on seeking ways to achieve the appropriate combination of lean and agile strategies (Mistry 2005:104; Hull 2005:230). Table 4.4 indicates a two-stage transition of supply chain strategies, first to "lean manufacturing", followed by a transition to an integrated "lean and agile" model which has been developed to address the changing perspectives of business today. This transition can be summarised in four main phases, as indicated in table 4.4.

Table 4.4: The supply chain evolutionary phase

SUPPLY CHAIN EVOLUTION PHASE	**I**	**II**	**III**	**IV**
SUPPLY CHAIN TIME MARKER	Early 1980s	Late 1980s	Early 1990s	Late 1990s
SUPPLY CHAIN PHILOSOPHY	Product-Driven	Market Orientated	Market Driven	CustomerDriven
SUPPLY CHAIN TYPE	Lean Functional Silos	Lean Supply Chain	Leagile Supply Chain	Customised Leagile Supply Chain
MARKET WINNERS	Quality	Cost	Availability	Lead Time
MARKET QUALIFIERS	(a) Cost (b) Availability (c) Lead Time	(a) Availability (b) Lead Time (c) Quality	(a) Lead Time (b) Quality (c) Cost	(a) Quality (b) Cost (c) Availability
PERFORMANCE METRICS	(a) Stock Turns (b) Production Cost	(a) Throughput Time (b) Physical Cost	(a) Market Share (b) Total Cost	(a) Customer Satisfaction (b) Value Added

Source: Christopher & Towill (2001:212)

As illustrated in table 4.4 above, as SCM has evolved, lean chains have increasingly come under pressure to become agile, and in some markets, further pressured to become customised. The challenges during each transition are significantly different and have led to the development of hybrid strategies. Christopher (2005:120) notes that the goal of a hybrid strategy should be to build an agile response upon a lean platform by seeking to follow lean principles up to the decoupling point and agile practice after that point. Christopher and Towill (2001:242) and Hilletofth (2009:20) visualised three distinct lean-agile hybrids. The first is founded on the Pareto rule, recognising that 80% of a company's revenue is generated from 20% of its products (Christopher 2005:70). It is suggested that the dominant 20% of the product assortment can be managed in a lean manner, given that demand is relatively stable for these items and that efficient replenishment is the appropriate objective, while the remaining 80% can be managed in an agile manner (Goldsby et al 2006).

The second lean-agile hybrid is founded on the principle of base demand and surplus demand, recognising that most companies experience a base level of demand over the course of the year. Krishnamurthy and Yauch (2007:597) suggest that base demand can be managed in a lean manner, while demand peaks over the course of peak seasons or heavy promotion periods can be managed in an agile manner (Christopher & Towill 2001:242; Goldsby et al 2006). The third lean-agile hybrid is founded on the principle of postponement. The foundation of postponement is that risk and uncertainty costs are linked to the differentiation of products that occurs during the activities in the supply chain (Hilletofth 2009:21). Costs in the supply chain can be reduced or fully eliminated by postponing certain activities (logistics and manufacturing activities) in the supply chain until customer orders are received (Faisal et al 2006:8858). Table 4.5 indicates the appropriate market conditions and operating environment for the three hybrid strategies.

Table 4.5: Hybrid strategies and the appropriate market conditions

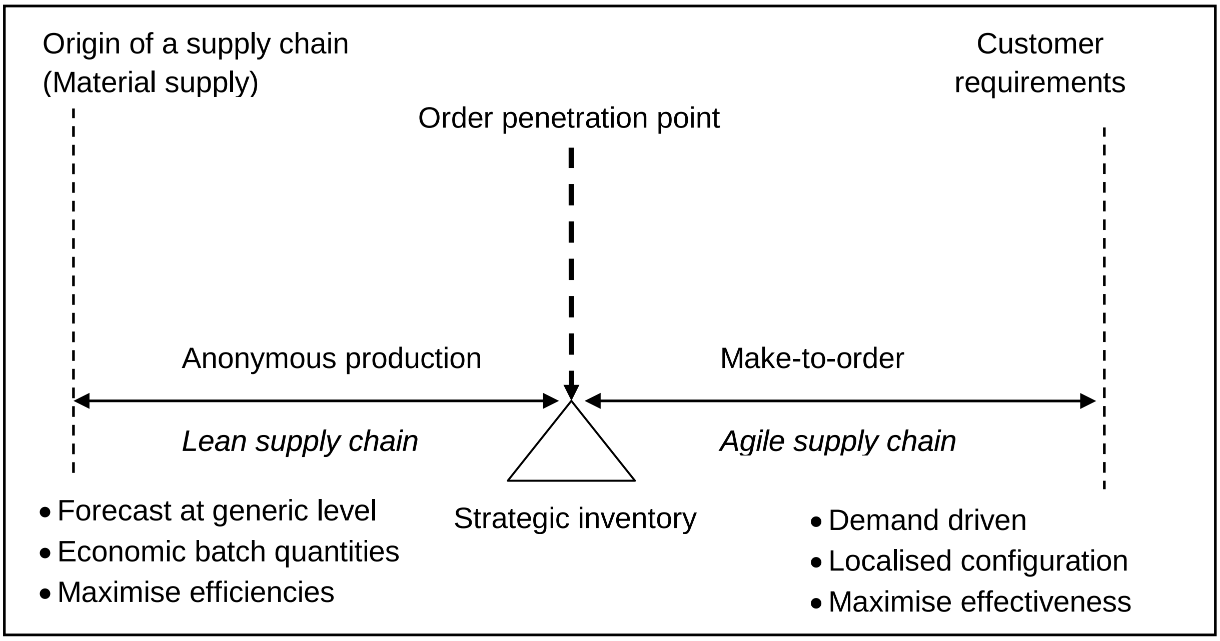
Hybrid strategies	**Appropriate market conditions and operating environment**
Pareto 80:20 Using lean method for volume lines, agile methods for slow movers	High level of variety; demand is nonproportionate across the range
Decoupling point The aim is to be lean up to the decoupling point and agile beyond it	Possibility of modular production or intermediate inventory; delayed final configuration or distribution
Surge/base demand separation Managing the forecastable element of demand using lean principles; using agile principles for less predictable demand	Where base level demand can be confidently predicted from past experience and where local manufacturing and small batch capacity are possible

Source: Christopher and Towill (2001:242); Faisal et al (2006:885)

4.4.4 The decoupling point

The decoupling point is the most cited of the three hybrid strategies (Wikner & Rudberg 2005). It separates the lean and agile paradigms. According to Hull (2005:230), this is the point where the product characteristics, to which customers' order, penetrate (Rahiminia et al 2009:802). That is the point where the order-driven and forecastable meet. Krishnamurthy and Yauch (2007:592) and Rahiminia and Moghadasian (2010:81) assert that lean and agile systems do not coexist, but have a demarcation between them. Figure 4.4 below illustrates the decoupling point of the lean and agile paradigms.

Figure 4.4: The decoupling point



Source: Adapted from Christopher (2005:121)

The decoupling point approach employs the concept of postponement, which is now increasingly and more widely used by organisations in a range of industries (Hull 2005; Wikner & Rudberg 2005; Rahiminia & Moghadasian 2010). The concept of postponement dates back to 1920. It can be defined as "the delaying of operational activities in a system until customer orders are received rather than completing activities in advance and then waiting for orders" (Krishnamurthy & Yauch 2007:592). The basic idea is to hold inventory in some generic or modular form and only complete the final assembly or configuration when the precise customer order is received (Christopher 2005:120; Jonsson 2008:157). A company may delay the forward movement (distribution) of products as long as possible in the chain of operations, keeping these product(s) in storage at central locations in the distribution chain (Hilletofth 2009:22). This can be through assembly (assembly-to-order), production (make-to-order) and souring or even design (engineer-to-order).

Hence the choice of a supply chain strategy is intimately related to the positioning of the decoupling point (Wikner & Rudberg 2005:624). The types of manufacturing strategies in which to place the decoupling point in order to determine supply chain paradigms have been well documented (Rahiminia & Moghadasian 2010:81). The four most common manufacturing activities based on speculation and customer order commitments are make-to-stock, make-to-order, configure-to-order and engineer-to-order (Taylor 2004:28; Cohen & Rousell 2005:12; Shapiro 2007:325; Webster 2008:218; Bowersox et al 2010:87).

4.4.5 The postponement strategy

In the leagile supply chain paradigm, lean and agile are combined within a total supply chain strategy by positioning the decoupling point (DP) in order to best suit the need for responding to a volatile demand downstream, but providing level scheduling upstream from the DP (Naylor, Mohammed, & Danny 1999). Postponement is used to move the DP closer to the end user and increase the efficiency and effectiveness of the supply chain (Yang & Burns 2003:2078). Postponement refers to a concept whereby activities in the supply chain are delayed until a demand is realised (Boone, Craighead & Hanna 2007:594). This involves intentionally delaying the execution of a task, instead of starting it with incomplete or unreliable information inputs (Yeung, Selen, Deming & Min 2007:332). Therefore postponement or delayed configuration is based on the principle of seeking to design products using common platforms, components or modules, but postponing the final assembly or customisation until the final market destination or customer requirement is known (Christopher 2003:288, 289).

Postponement basically involves holding inventory in a generic form, in the fewest locations, and only finishing or finally configuring the product once real demand is known (Christopher 2003:286). Postponement is used to manage uncertainties and the final operations that result in a customised product for the end customer are performed when the uncertainty is removed (Taylor 2004:311). This is necessary because the upstream parts of the supply chain are insulated from final customer demand by the intervening tiers of supply chain members (Waters 2007:206). Postponement is an important organisational concept that can be used to improve a firm’s performance. It allows organisations to be flexible in developing different versions of a product, as needed (Jeong & Hong 2007:585). It has the potential to improve responsiveness while reducing costs such as inventory, transport, storage and obsolescence costs (Boone et al 2007:594). The benefits of postponement include following JIT principles, reducing end-product inventory and making forecasting easier (Cheng, Li, Wan & Wang 2010). Postponement has drawbacks as well. Implementation can reduce economies of scale and result in longer lead times. Furthermore, implementation of postponement requires a redesign of the supply chain, which may involve higher costs as well (Cheng et al. 2010).

Postponement is an excellent example of a push-pull strategy (Simchi-Levi, Kaminsky & Simchi-Levi 2008:190). Before end customer demand is known, a push-based strategy is used to produce generic products based on a forecast. The demand for generic products is an aggregation of demand for all the organisation's corresponding end products and therefore forecasts are more accurate. By contrast, customer demand for a specific end product typically has a high level of uncertainty and product differentiation therefore occurs only in response to individual demand. The portion of the supply chain starting from the time of differentiation is pull-based (Simchi-Levi et al 2008:191). Earlier, the decoupling point was defined as the point at which real demand penetrates upstream in a supply chain (Christopher 2003:28). From this, it can also be derived that the push-pull boundary is the same point as the decoupling point. Postponement takes place at the decoupling point or the push-pull boundary and the decoupling point determines the form in which inventories are held. Hence once the decoupling point is determined, organisations must support push-pull decisions to support customers' expectations (Goldsby et al 2006:60).

4.4.5.1 Forms of postponement

The various forms of postponement include full postponement, assembly/logistics postponement, manufacturing postponement and full speculation, as discussed below.

a Full postponement

Full postponement refers *to* "making the decoupling point earlier in the process", meaning that few steps of the design process will be performed under uncertainty and forecasting (Świerczek 2010:35). At the same time, it decreases the necessary stock of semifinished goods. For this postponement strategy to be successful, processes have to be designed in such a manner that less differentiating steps can be performed prior to the decoupling point

(Balland & Lindholm 2012:7). This will increase forecast accuracy, which is a key success driver for the full postponement strategy to be profitable (Balland & Lindholm 2012:7). The steps after the decoupling point have to be performed in a flexible and fast way, so that the customer is served quickly. It is also important that customer orders are captured correctly, as they initiate the steps after the decoupling point. An order that is captured incorrectly/incompletely will lead to a product that does not fulfil customers' expectations (Balland & Lindholm 2012:7).

b Assembly/logistics postponement

Assembly postponement refers to the movement of finished goods (Yang, Burns & Backhouse 2004). It is also referred to as semifinished goods (Gattorna 1998), where the last differentiating stages are performed at the warehouse/distribution centre (DC). Gattorna (1998) refers to stages such as labelling, packaging and assembly. These delayed processes allow a product to be centrally stored and customised according to local market specificities when a customer order is received. Manufacturing processes are based on speculation and logistics processes are customer-order initiated (Balland & Lindholm 2012:8).

This strategy also allows organisations to store inventory at a centralised and strategic location. Hence inventory is reduced as well as available in the right place, at the right time (Yang et al 2004). Some organisations applying logistics postponement choose to store the inventory upstream in the supply chain. This is usually done at the manufacturer's warehouse, and is consequently shipped straight from the manufacturer to the customer (Balland & Lindholm 2012:8). Logistics postponement can help companies improve their on-time deliveries of complete orders, have reliable and shorter lead times, introduce new products faster, reduce inventory costs, and stabilise transportation costs (Świerczek 2010:35). However, companies must ensure that the entities performing the postponed steps have adequate knowledge and capabilities. The postponement of those steps must not lead to degradation. A drawback to logistics postponement is that shipping costs may increase as products are shipped in smaller quantities, using faster modes in order to decrease lead-time (Balland & Lindholm 2012:8).

c Manufacturing postponement

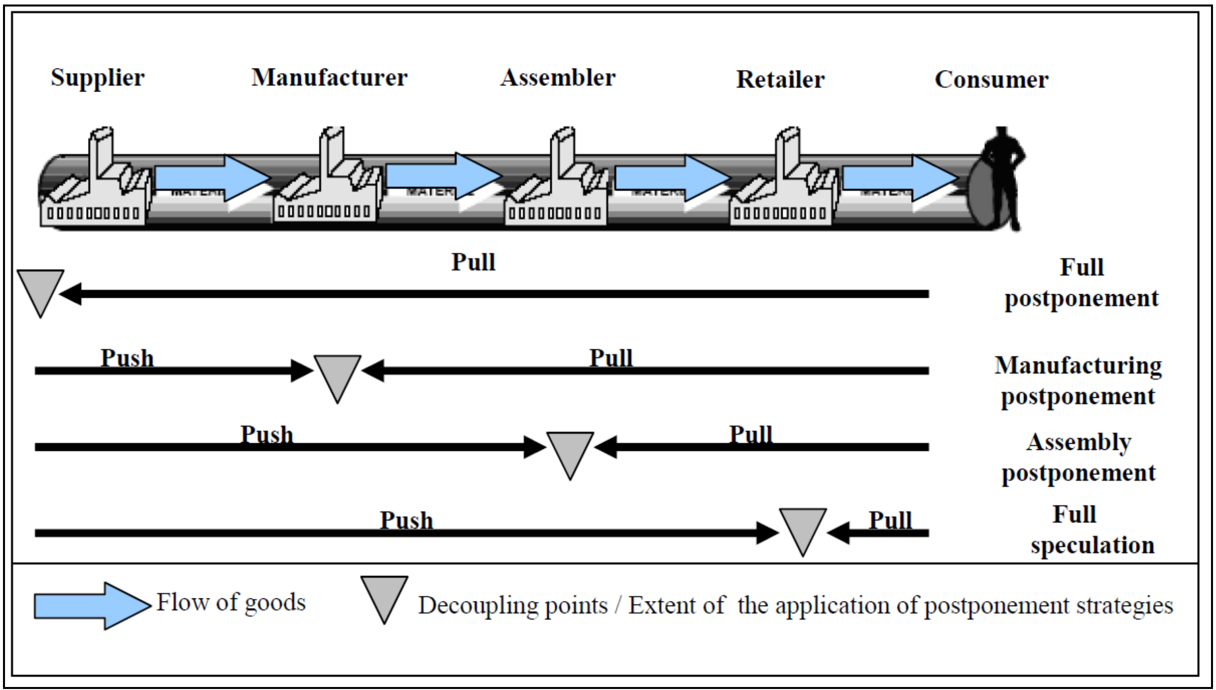
Manufacturing postponement focuses on designing products so that they are kept undifferentiated for as long as possible (Yang et al2004). This decreases inventory since components can be used for multiple products. Relevant processes are labelling, packaging, assembly or manufacturing (Świerczek 2010:35). The manufacturing process is redesigned to allow processes not differentiating the product, and based on forecasts, to be completed prior to the customer order decoupling point (CODP). The processes that differentiate the product are placed after the CODP and they are customer order initiated. For instance, Benetton places the dying process of its clothes after the knitting process, allowing a more accurate demand of colours (Gattorna 1998).

The following three formalised approaches are used in manufacturing postponement: (1) standardisation; (2) modular design; and (3) process restructuring. Standardisation is done in the design stage of products, designing them in a manner that makes components the same for multiple products (Yang et al 2004). However, too much standardisation reduces product differentiation and finally leads to cannibalism (Świerczek 2010:35). Modular design has two forms: modularity in design and modularity in production. Modularity in design relates to the boundaries of a product and its components, which are designed in such a way that interdependencies between features and tasks are avoided between specific component designs (Yang et al 2004).This means that a change in one component does not impact and/or require changes in other components (Balland & Lindholm 2012:9).

d Full speculation

Full speculation is the opposite of postponement in any form (full, logistics or manufacturing). The full speculation strategy can, in one way, be compared to a MTS production strategy. In this strategy, all manufacturing operations are performed without any involvement from the customer (Balland & Lindholm 2012:7). The product is distributed in a decentralised way, often in large volumes. Therefore, those large volumes allow using economies of scale at several points in the supply chain. In addition, products will be stored closer to the customer, which can be considered advantageous as lead-time to customer decreases (Świerczek 2010:35). However, this can also be regarded as a disadvantage since it increases the investment in inventory and warehousing space. Finally, it can also lead to obsolete products or a need to ship products between warehouses. For this strategy, the CODP is at the very end of the supply chain, and no customisation is possible (Balland & Lindholm 2012:11). Figure 4.5 depicts the various forms of postponement.

Figure 4.5: Forms of postponement



Source: Świerczek (2010:35); Balland & Lindholm (2012:11)

The four stages indicated in figure 4.5 can determine the extent of application of postponement strategies in a supply chain (Świerczek, 2010:35): make-to-stock (MTS) is typical for full speculation strategy, configure-to-order (CTO) refers to assembly/logistics postponement, make-to-order (MTO) is linked to manufacturing postponement and engineer-to-order (ETO) corresponds to full postponement. These points indicate different degrees of application of postponement strategies in supply chains. Hence the location of the material decoupling point is often perceived as a primary tool to indicate the extent of the application of postponement strategies in supply chains.

4.5 CHAPTER SUMMARY

In today's turbulent environment, organisations can no longer act as isolated and independent entities. As supply chains have moved from a cost focus, to a customer focus and to a strategic focus, the need to think strategically about the supply chain has developed. An optimal supply chain strategy, linked to operational excellence, can provide success for not only the firm in question but also its partners and customers. Customers are more informed and express more concern regarding reduced lead time, just-in-time delivery and value-added services. They want greater responsiveness and reliability from their suppliers, whereas supply chain managers want low costs so that they remain competitive. This chapter focused on supply chain strategy. The concept of supply chain strategy, methods of designing specific supply chain strategies and the characteristics and attributes of different supply chain strategies were discussed. The next chapter deals with the framework for determining supply chain practices and strategies.

CHAPTER 5

FRAMEWORK FOR DETERMINING SUPPLY CHAIN PRACTICES AND STRATEGIES

5.1 INTRODUCTION

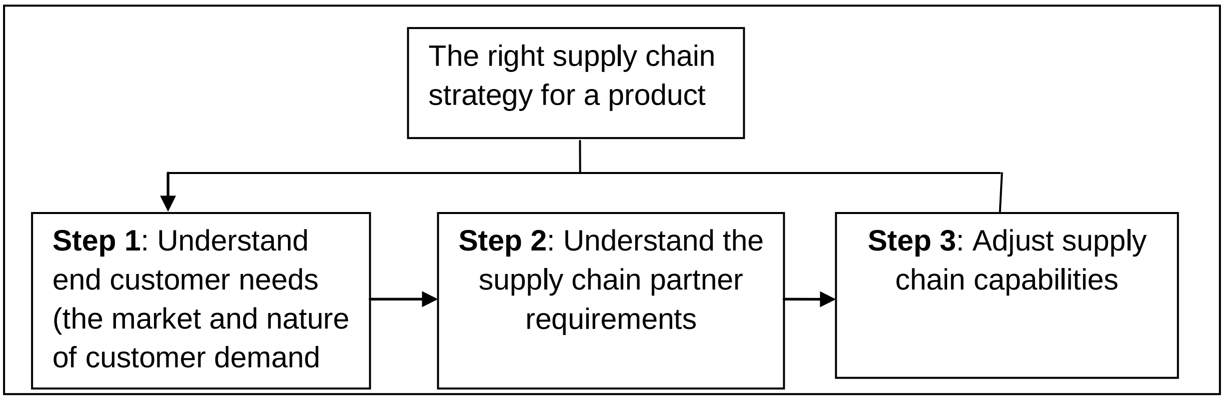
Chapter 4 dealt with supply chain strategies. In chapter 5, the instruments for determining supply chain strategies and practices will be discussed. The chapter articulates that a supply chain strategy determines the practices in the supply chain and that this strategy is not fixed. Different strategies work best in different circumstances. The chapter presents supply chain as a competitive force and suggests a research framework for evaluating supply chain practices and strategies in the South African automotive industry.

5.2 VIEWING SUPPLY CHAIN STRATEGY AS A COMPETITIVE FORCE

The ultimate goal of a supply chain is to successfully deliver products and services to end customers (Wisner et al 2012a:506). Various approaches have been suggested for the most effectively designed supply chains to meet customers' needs (Sebastiao & Golicic 2008). According to Ismail and Sharifi (2006:437), Sharifi et al(2006:1083), Hines (2006:57), Fawcett et al (2007:222) and Chopra and Meindl (2010:41), important and critical processes for choosing a supply chain strategy include the following: understanding market requirements and the current situation regarding the supply chain; determining supply chain performance attributes based on an analysis of customer requirement and the current situation in the supply chain; determining supply chain performance dimensions that stand for the areas where the supply chain attributes can be deconstructed to more concrete performance dimensions; translating supply chain dimensions into supply chain functions, thus converting the conceptual supply chain to an actual supply chain; and designing and examining all the components and aspects of the desired supply chain against market requirements and the current situation (Wisner et al 2012:506).

A supply chain strategy can be chosen using three basic steps that will be aligned with the business strategy. The first step is to understand the end customer's needs (the markets and the nature of customer demand). The second step is to understand supply chain partner requirements (competency requirement). The third step is to adjust supply chain member capabilities (choose the strategy applicable to the product). Figure 5.1 illustrates the steps in choosing supply chain strategies.

Figure 5.1: Framework for designing a supply chain strategy



Source: Researcher's own construction

5.2.1 Step 1: understanding the end customer needs (the market and customer demand)

In today's business environment, companies must make efforts to segment (market) customers based on their needs. Customers are more demanding, not only of quality, but also of service (Sahay, Gupta & Mohan 2006:16). Hence for an organisation to make the right decision on the type of supply chain strategy, it must understand customer needs and demands (Hines 2006:57; Chopra & Meindl 2010:41). It is important for an organisation to understand the customer by being customer focused and recognising the key requirements in each market segment it serves as well as the nature and structure of its own supply chain (Hines 2006:57).

The six key market variables that determine the attributes of a supply chain structure are volume, time, variety, service level required, price and rate of change, innovation and new product development (Hines 2006:58). Fawcett et al (2007:222) and Chopra and Meindl (2010:41) maintain that customer demand from different market segments varies along several attributes, such as the following:

- The quantity of the product needed in each lot for example, an emergency order for material needed to repair a production line is likely to be small, while an order for material to construct a new production line is likely to be large.
- The response time that customers are willing to tolerate, for example the tolerated response time for the emergency order is likely to be short, whereas the allowable response time for the construction order is likely to be long.

- The variety of the product needed, for example a consumer may place a high premium on the availability of all parts of an emergency repair order being from a single supplier.
- The service level required, for example a customer placing an emergency order expects a high level of product availability. This customer may go elsewhere if all parts of the order are not immediately available.
- The price of the product, for example a customer placing an emergency order is apt to be much less sensitive to price than the customer placing a construction order.
- The desired rate of innovation in the product, for example customers at a high-end department store expect a lot of innovation and new designs in the store's apparel.

The purpose of targeting a customer or market segment is to identify similarities between groups of customers so that their needs can be satisfied efficiently (Hines 2006:58). Customers in different market segments may have similar needs to other segments or the difference may be greater than the similarities. Failure to segment markets according to customers' needs may lead to uncertainty in fulfilling their requests. Chopra and Meindl (2010:41) draw a distinction between demand uncertainty created by the customer in the market and implied demand uncertainty. Implied demand uncertainty is the uncertainty imposed on the supply chain because of the customer needs it seeks to identify, whereas demand uncertainty reflects the uncertainty of customer demand for a product (Chopra & Meindl 2010:41). Implied demand uncertainty is the uncertainty for the portion of the demand that the supply chain plans to satisfy only based on the attributes of the customer. Table 5.1 indicates examples of the impact of customer needs on implied demand uncertainty.

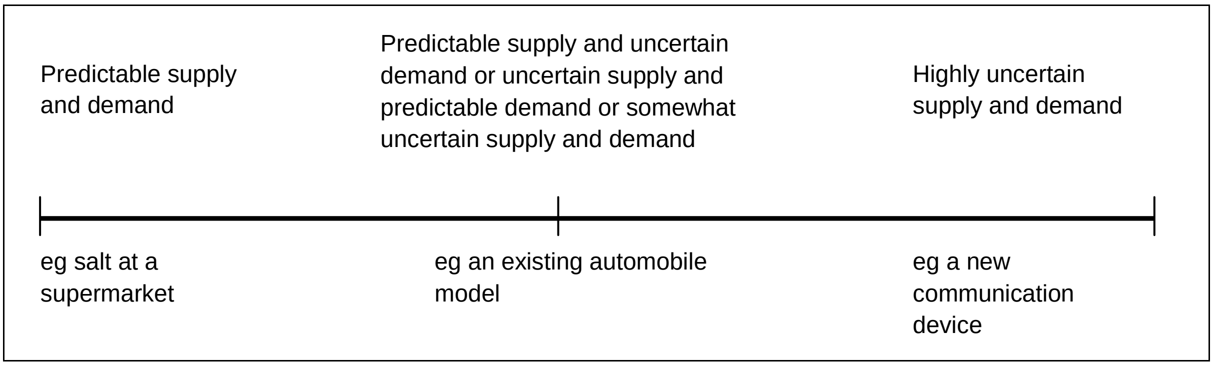
Table 5.1: The impact of customer needs on implied demand uncertainty

Customer needs	**Cause the implied demand uncertainty to**
Range of requirement increases	increase because a wider range of the requirement implies greater variance in demand
Lead time decreases	increase because there is less time in which to react to orders
Variety of products required increases	increase because demand per product becomes more disaggregate
Number of channels through which product may be required increases	increase because the total customer demand is now disaggregate over channels
Rate of innovation increases	increase because new products tend to have more uncertain demand
Required service level increases	increase because the firm now has to handle unusual surges in demand

Source: Chopra & Meindl (2010:42)

Supply chain uncertainty is strongly affected by the product life cycle of a product. New products being introduced have higher supply uncertainty. This is because design and production processes are still evolving. Mature products have less supply uncertainty (Chopra & Meindl 2010:43; Hines 2006:60). Several factors contribute to risk in various portions of the supply chain and this increases uncertainty. Figure 5.2 below depicts the implied uncertainty spectrum.

Figure 5.2: The implied uncertainty (demand and supply) spectrum



Source: Chopra & Meindl (2010:43)

According to Jacobs et al (2009:362), a framework was developed by Fisher to help managers understand the nature of their product and devise a supply chain that can best satisfy demand. Based on Fisher's (1997) framework, demand for a product can be categorised as either primarily functional or primarily innovative (Lee 2002:106; Selldin & Olhager 2007:43; Jacobs et al 2009:362). Each of the categories requires distinctive different kinds of supply chain. A mismatch between the type of product and the type of supply chain may cause SCM problems. Table 5.2 below indicates the difference between functional and innovative products based on the characteristics of demand in the market.

Table 5.2: Characteristics of the dimensions of demand and supply

Demand characteristics	
Functional	***Innovative***
Low demand uncertainties	Higher demand uncertainties
More predictable demand	Difficult to forecast
Stable demand	Variable demand
Long product life	Short selling season
Low inventory cost	High inventory cost
Low profit margins	High profit margins
Low product variety	High product variety
Higher volume per SKU	Low volume per SKU
Low stockout cost	High stockout cost
Low obsolescence	High obsolescence

Source: Adapted from Verdouw & Verwaart (2008)

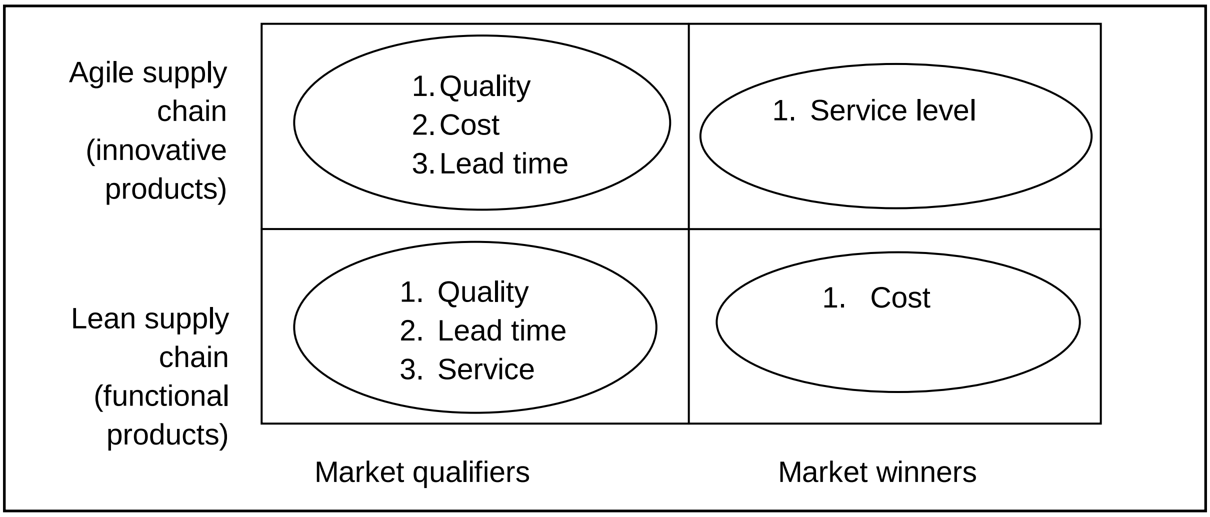
As shown in the table 5.2 above, functional characteristics include stable items that people buy in a wide range of retail outlets such as grocery stores and gas stations. These products satisfy basic needs, which do not change much over time. They have stable, predictable demand and long life cycles (Christopher 2005; Sanderson & Cox 2008:17; Jacobs et al 2009:362; Jonsson 2009:383). However, their stability leads to competition, which often leads to low profit margins. According to Sanderson and Cox (2008:17) and Jacobs et al (2009:363), specific criteria suggested by Fisher for indentifying functional products include a product life cycle of more than two years, a contribution margin of 5 to 20%, only 10 to 20% product variation, an average forecast error at time of production of only 10% and a lead time for make-to-order products from six months to one year. Sanderson and Cox (2008:17) further assert that because functional products satisfy the basic needs shared by most consumers, there is little variation and customisation in product offerings. Hence Mason-Jones et al (2000) classify such products as commodities.

However, as stated by Jacobs et al (2009:263), innovative products are those that compete through their design or basis on a unique concept. They typically have a life cycle of only a few months (Sanderson & Cox 2008:17). They have short life cycles, and great variety is typical of these products which further increases unpredictability. According to Jonsson (2009:384), profit margins for these products are considerably higher compared to functional products. However, they run the risk of stock-out and obsolescence. This means that products in stock must be scrapped or sold at reduced prices at the end of the sales season. It is argued that this extensive variety compounds a product's newness to further increase the unpredictability of demand (Sanderson & Cox, 2008:17). Mason-Jones et al (2000) classify such products as fashion goods.

Sanderson and Cox (2008:17) emphasise that a key limitation of Fisher's categorisation is that it is focuses on the demand generated by customers for products delivered by a repeated manufacturing process. Consequently, it is implicit in Fisher's discussion that both functional and innovative products have a past, a present and a future state. In functional products, each of the three states is assured to be broadly similar. This means that past and present demand can be used with a reasonable degree of certainty as a guide for future demand. However, with innovative products the past, present and future states are each substantially different. This means that past and present demand cannot be used with any real certainty to predict the future.

Another important criterion that determines the nature of customer demand is the market winner and qualifiers. The concept of so-called "order qualifiers" and "order winners" advocates the basis on which manufacturing strategies should be determined (Christopher & Towill 2002). Order qualifiers are the baseline for entering into a competitive arena while order winners are the specific capabilities that an organisation has to actually win orders. The concept of order qualifiers and order winners leads to the specification of an appropriate manufacturing strategy. It is on this basis that the concept of so-called "market qualifiers" and "market winners" developed. The notion here is that being truly competitive requires not only the appropriate manufacturing strategy, but also an appropriate holistic supply chain strategy. There is a critical connection between the concepts of qualifiers and winners and leanness and agility. The lean paradigm is most powerful when the winning criterion is cost. However, when service and customer value enhancement are prime requirements for market winning, then the likelihood is that agility will become the critical dimension. Figure 5.3 illustrates the crucial differences in focus between the lean and agile paradigm depending upon market qualifiers and market winners (Mason-Jones et al 2000:4064).

Figure 5.3: Market qualifiers and market winners



Source: Mason-Jones et al (2000:4064)

As indicated in the figure above, the market winner for agile supply chain is service, while the market winner for lean supply chain is cost (Rahiminia et al 2009:801).

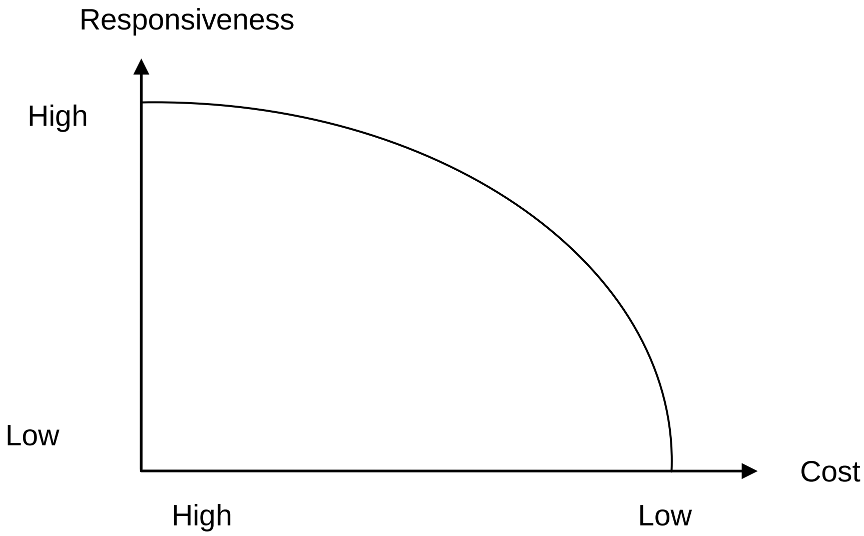
5.2.2 Step 2: understanding supply chain partner requirements

Supply chains have different characteristics but all supply chains have two significant attributes: cost and service (Taylor 2004:280). Service is closely linked to responsiveness and the question here is: "how responsive is the supply chain" to meeting customer demands. As advocated by Hines (2006:61) and Chopra and Meindl (2010:44), supply chain responsiveness includes a supply chain's ability to do the following:

- Respond to wide range of quantities demanded.
- Meet short lead times.
- Handle a large variety of products.
- Build highly innovative products.
- Meet a high service level.
- Handle supply uncertainty.

There is a trade-off between responsiveness (service) and cost (Taylor 2004:280; Hines 2006:61). Responsiveness comes at a cost (Chopra & Meindl 2010:44). For instance, to respond to a wide range of quantities demanded, capacity must be increased, which increases cost. Increase in cost leads to the concept of "supply chain efficiency". This leads to the inverted cost of making and delivering a product to the customer (Taylor 2004: 280; Hines 2006:61; Chopra & Meindl 2010:44). Increase in cost lower efficiency. For every strategic choice to increase responsiveness, there are additional costs that lower efficiency. This philosophy has led to the term "efficient frontier" (Taylor 2004:280; Hines 2006:61; Chopra & Meindl 2010:44). According to Taylor (2004:281), the "efficient frontier" is an intermediary "win-win" situation that allows two qualities to be combined to some degree with an upper bound (the constraint of the total of the two). Chopra and Meindl (2010:44) note that efficient frontier shows the lowest possible cost for a given responsiveness. Lowest cost is defined on the basis of existing technology and not every firm is able to operate on the efficient frontier. The efficient frontier represents the cost-responsiveness performance of the best supply chains. A firm that is not on the efficient frontier can improve both its responsiveness and its cost performance by moving towards the frontier. Figure 5.4 below shows the framework of a cost-responsiveness efficient frontier.

Figure 5.4: Cost-responsiveness efficient frontier



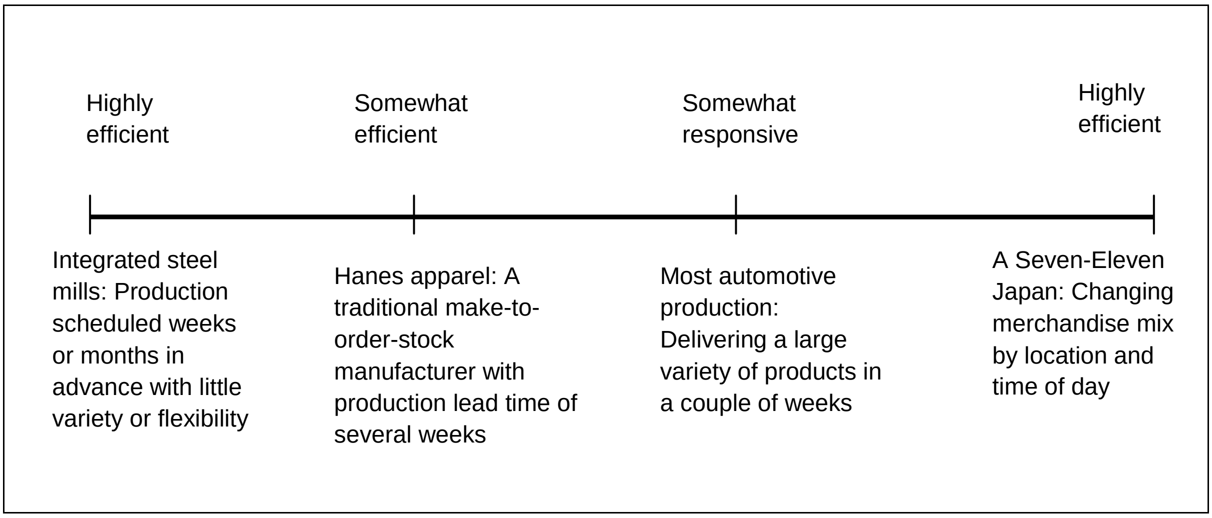
Source: Chopra & Meindl (2010:44)

However, a firm on the efficient frontier can improve its responsiveness only by increasing cost and becoming less efficient. Therefore firms on the efficient frontier must continuously improve their processes and change technology to shift the efficient frontier itself. Given the trade-off between cost and responsiveness, a key strategic choice is the level of responsiveness an organisation seeks to provide (Chopra & Meindl, 2010:45). As noted by Taylor (2004:281), the primary consideration in deciding where to place a company along the trade-off curve is the choice of the corporate positioning strategy. In the manufacturing sector, positioning is based on three qualities: product, price and service. The goal of the organisation should be to adopt a defensible position in the market, based on some combination of these qualities.

5.2.3 Step 3: adjusting supply chain member capabilities (strategic fit)

Putting responsiveness and efficiency in supply chains as a trade-off recognises that different levels of responsiveness have associated cost implications (Taylor 2004: Hines 2006:61). As shown in figure 5.4, the levels of responsiveness in the supply chain depend on increasing cost. Increase in cost lowers efficiency but increases responsiveness. Figure 5.5 illustrates the responsiveness spectrum. It provides an example of the competitive strategy of McMaster-Carr, with an option of designing an efficient or responsive supply chain.

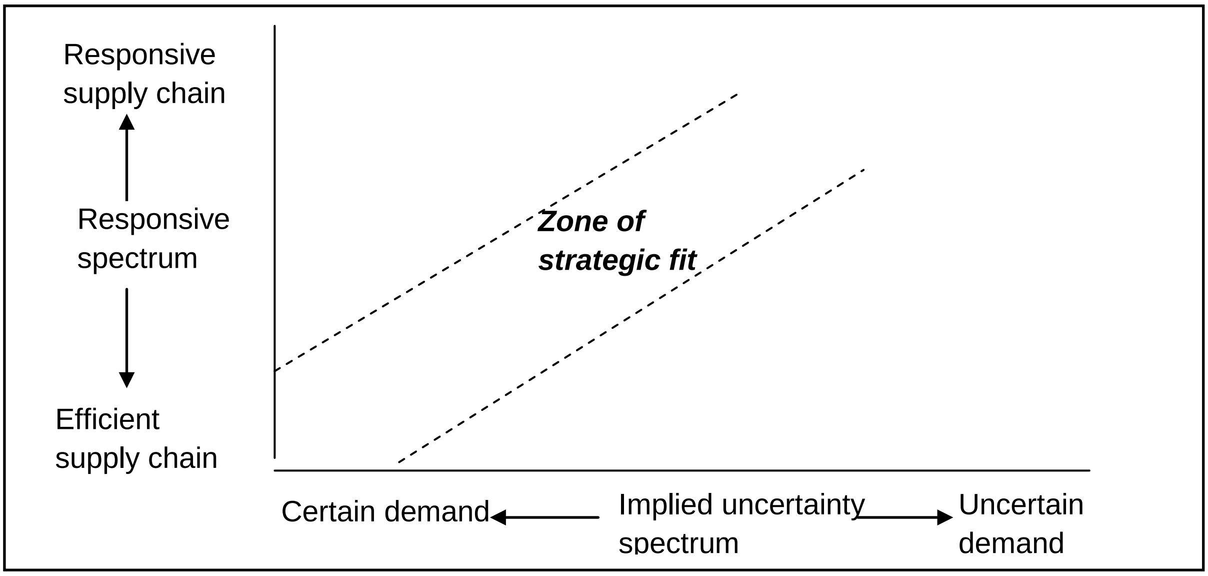
Figure 5.5: The responsiveness spectrum



Source: Chopra & Meindl (2010:45)

After mapping the level of implied uncertainty and understanding the supply chain position on the responsiveness spectrum, it is necessary to ensure that the degree of responsiveness is consistent with the implied uncertainty. Hull (2005:220), Hines (2006:62), Jonsson (2009:384) and Chopra and Meindl (2010:46) concur that understanding customer needs and designing a supply chain strategy that can meet their needs is what customer focus is all about. Figure 5.6 illustrates the trade-off in achieving a strategic fit.

Figure 5.6: Achieving strategic fit in the supply chain



Source: Hines (2006:62)

To achieve complete fit, a firm must ensure that all its functions maintain consistent strategies that support the competitive strategy. All sub-strategies in the supply chain, such as manufacturing, inventory and purchasing, need to be consistent with the supply chain level of responsiveness. Firms with different locations along the spectrum must have different supply chain design and different functional strategies that support the spectrum (Chopra & Meindl, 2010:48). Table 5.3 compares efficient and responsive supply chains.

Table 5.3: Comparison of efficient and responsive supply chains

	Physically efficient supply chain	**Market responsive supply chain**
Primary purpose	Supply predictable demand efficiently at the lowest possible cost	Respond quickly to unpredictable demand in order to minimise stockouts, forced markdowns and obsolete inventories
Manufacturing focus	Maintain high average utilisation rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimise inventory throughout the chain	Deploy significant buffer stocks of parts or finish goods
Lead time focus	Shorten lead times as long as they do not increase costs	Invest aggressively in ways to reduce lead times
Approach to choosing suppliers	Select primarily for costs and quality	Select primarily for speed, flexibility and quality
Forecasting	Forecast product variants	Forecast capacity need
Product-design	Maximise performance and minimise cost	Use modular design in order to postpone product differentiation for as long as possible
Information exchange	Highly desirable	Obligatory

Source: Jonsson (2009:384)

It can therefore be concluded that efficient supply chain focuses on delivering products at the lowest possible cost to customers (functional) while in responsive supply chains, speed and flexibility are required from suppliers, manufacturers and from product design solutions (innovative products) (Kaipia & Holmstrom 2007:4). Hence the two types of products place different demand on the supply chain process. Figure 5.7 depict the match and mismatch model for choosing the right supply chain design for a product as developed by Fisher (1997).

Figure 5.7: Supply chain uncertainty framework

		DEMAND UNCERTAINTY	
		LOW (FUNCTIONAL PRODUCTS)	HIGH (INNOVATIVE PRODUCTS)
SUPPLY UNCERTAINTY	LOW (STABLE PROCESS)	Grocery, basic apparel, food, oil and gas **Efficient Supply Chain**	Fashion apparel, computers, popular music **Responsive Supply Chain**
	HIGH (EVOLVING PROCESS)	Hydroelectric power, some food produce **Risk-Hedging Supply Chain**	Telecom, high-end computers, semiconductor **Agile Supply Chain**

Source: Jacobs et al (2009:364)

It is more challenging to operate a supply chain that is in the right column than in the left one. Similarly, it is more challenging to operate a supply chain that is in the lower row than the upper row (Jacobs et al 2009:364). Before setting up a supply chain strategy, it is necessary to understand the resources of the underlying uncertainties and explore ways to reduce these uncertainties. If it is possible to move the uncertainty characteristics of the product from the right column to the left or from the lower row to the upper, supply chain performance will improve (Jacobs et al 2009:364).

5.2.4 Conclusion

From the analysis above it is clear that putting responsiveness and efficiency as a trade-off, recognises that different levels of responsiveness are associated with cost implications (Taylor 2004; Hines 2006:61). The level of responsiveness in the supply chain depends on increasing cost. Increase in cost lowers efficiency but increases responsiveness. In deciding upon the type(s) of supply chain strategy to choose, it is necessary to understand what the customer needs (Hull 2005:220; Hines 2006:62; Jonsson 2008:384; Chopra & Meindl 2010:46). Designing a supply chain strategy that can meet the customer's needs is what customer focus is all about. Customer needs should therefore be the main focus. This point of focus helps an organisation to achieve strategic fit. To achieve complete strategic fit, an organisation must ensure that all its functions maintain consistent strategies that support the competitive strategy. All substrategies in the supply chain, such as manufacturing, inventory and purchasing, need to be consistent with the supply chain level of responsiveness. Firms with different locations along the spectrum must have different supply chain design and different functional strategies that support the spectrum (Chopra & Meindl 2010:48).

An efficient supply chain focuses on delivering products at lowest possible costs to customers (functional), while in a responsive supply chain, speed and flexibility are required from suppliers, manufacturers and product design solutions (innovative products) (Kaipia & Holmstrom 2007:4). Supply chain strategies vary according to the discipline from which they originate. However, their intent is consistently to reduce uncertainties and cost while satisfying the end customers' needs (Hines 2006:58). Supply chain strategies may also be designed to be more efficient and/or more effective. Within these parameters, supply chains can be grouped into two broad categories that summarise their core competencies and capabilities in meeting the end customers' needs. According to Christopher and Towill (2002:8), an efficient supply chain is also known as a "lean" supply chain, while a responsive supply chain is known as an "agile" supply chain (Nel & Badenhorst-Weiss 2010:205).

5.3 INSTRUMENT FOR DETERMINING SUPPLY CHAIN STRATEGIES

5.3.1 Introduction

Given the complexity to satisfy customers' demand, there is the need for different supply chain strategies to be developed for different product lines. It is important to understand the relationships between products and production as well as the product and supply chain to be able to determine the practices in SCM for achieving competitive advantage (Stavrulaki & Davis 2010:128). A supply chain specifies how a firm will achieve its competitive advantage through its supply chain capabilities such as efficiency, speed and flexibility (Qi, Zhao & Sheu 2011:372). It also specifies practices in the supply chain such as how the manufacturing, purchasing, marketing and logistics functions work together to support the desired competitive strategy (Qi et al 2011:372).

Regarding the theoretical development discussed in section 5.2, some of the instruments for determining supply chain strategies used in this study include product characteristics, manufacturing characteristics, and decision drivers of SCM.

5.3.2 Determining supply chain strategies based on product characteristics

There are essentially two types of products in markets, as highlighted above. These products are functional and innovative products (Fisher 1997: 106; Selldin & Olhager 2007:43; Qi et al 2009:672). In discussing the differences between functional and innovative products, it is also necessary to consider what features of a product qualify it for selection by a customer (order qualifiers) and what features the product has that will cause the customer to choose it over competitors (order winners). Because of their substitutability, functional products tend to have price as their market winner (the customer can, after all, buy a nearly identical product easily from a competitor), while product quality, lead time and availability are market qualifiers (Christopher & Towill 2001:237). By contrast, availability (and inherently service level) is the market winner for innovative products, with quality, price and lead time as the market qualifiers. That is, you cannot acquire a share of an innovative product's market unless the product is available for the public to purchase and has supporting high levels of service (Mason-Jones et al 2000:55).

The two product types respond to different marketplace pressures. Functional products have a predictable demand pattern and customers that expect lowest cost. Innovative products have volatile demand with customers who expect that supplies will be available to meet their demand (Mason-Jones et al 2000:56). In reality, many products demonstrate features of both functional and innovative products, and there is a continuum scale with the extremes at either end. According to Fisher (1997:106) and Qi et al (2009:669), functional products require a physically efficient supply chain while innovative products require a market responsive supply chain. Hence deciding whether your product is functional or innovative can also be complicated by the fact that some products can be either. Each product category should therefore have a different supply chain approach to address its specific characteristics, and the key to effective supply chain design is to match the product to its ideal supply chain.

The product life cycle for functional products is more than two years, while for innovative products, it is three months to one year. Functional products have a low product variety of 10 to 20 variants per category while for innovative products, product variety is high. Moreover, the make-to-order lead time for functional products is six months to a year while for innovative product; it is one day to two weeks. Table 5.4 shows the characteristics of products used in this study and the effect on supply chain strategies.

Table 5.4: Aligning product characteristics and supply chain strategies

Product characteristics	**Lean supply chain strategy**	**Agile supply chain strategy**
Type of product	Standard (functional products)	Customised (innovative products)
Order lead time	Long order lead time (six months to one year)	Short order lead time (one day to two weeks)
Demand uncertainty	Predictable demand	Unpredictable demand
Market winner	Cost	Availability
Product life cycle	Long (more than two years)	Short (three months to a year)
Forecasting	Relatively accurate	Demand driven
Product variety	Low (10 to 20 variants per category)	High (often millions of category per variants)

Source: Researcher's own construction

5.3.3 Determining supply chain strategies based on manufacturing characteristics

The foundation for determining the relationship between manufacturing characteristics in this study is based on identifying four representative supply chains that are appropriate for different manufacturing environments. These include make-to-stock (MTS),assemble-to-order (ATO) or configure-to-order (CTO); make-to-order (MTO) and design-to-order (DTO) or engineer-to-order (ETO).

5.3.3.1 Make-to-stock (MTS) supply chain

In a MTS supply chain, the end consumer has no individual inputs into the configuration of the product, and typically purchases the product from a retailer. MTS supply chains are extremely common because they are appropriate for high-volume, low-profit margin, commodity products (Jonsson 2008:153). These low-cost products tend to have a relatively stable demand, which can therefore be forecast with a low degree of error when accurate historical demand information is available (Stavrulaki & Davis 2010:134).

The production processes for these mature, highly standardised products focus primarily on achieving low-cost operations, which are typically accomplished with high-volume transformation processes, such as continuous processes or high-volume assembly lines. Production is often highly automated resulting in little or no labour. Manufacturers in these supply chains tend to push products onto retailers' shelves or showrooms based on end product forecasts. The product flow relies heavily on distribution centres and retailers that deliver products to consumers in the most cost-efficient manner. MTS supply chains must relentlessly focus on minimising costs (Taylor 2004:28). Hence information sharing initiatives such as quick response, efficient consumer response and vendor-managed inventory are common in MTS supply chains (Balakrishnan & Geunes 2004:2; Bowersox et al 2010:87).

5.3.3.2 Configure-to-order (CTO) supply chain

This supply chain provides customers with a limited number of choices in the configuration of the final product. Customers can pick and choose from various standard components that are available in order to produce their own product, but have no control at individual level in determining the design of these components. In order to offer customers a number of options, companies typically delay the final assembly of products until orders are received (Jonsson 2008:153).

CTO supply chains are typically appropriate for higher priced consumer goods that are assembled to individual end customer specifications. These products are also frequently updated with the latest technologies, increasing their rate of obsolescence. In the CTO supply chain, forecasting takes place at the component level where aggregate demand tends to increase accuracy. In contrast to the MTS supply chain, where the final product is immediately available to the customer, CTO supply chains necessarily imply a certain amount of waiting from when an order is placed to when the product is actually received. A modular approach is often used in both the design and production of CTO products to address the trade-off between efficiency and flexibility. In modular production processes, standardised components are produced efficiently in appropriate batch sizes and then assembled to meet individual customer orders (Stavrulaki & Davis 2010:136).

The major management challenge with the CTO supply chain is the need to carefully balance the pressures of achieving low cost, timely production and delivery (both of which are essential to remain competitive), while still offering a wide range of product variety. In other words, CTO supply chains must embrace both agile and lean elements in their capabilities. Such hybrid supply chains are often called leagile (Christopher & Towill 2001:242) and relate to a postponement supply chain strategy (Skipworth & Harrison 2006:628) since the actual production is postponed until individual customer information is available. Leagile supply chains separate their lean and agile focus in reference to a decoupling point (Mason-Jones et al 2000:55).

5.3.3.3 Make-to-order (MTO) supply chain

The MTO supply chain affords consumers the opportunity to have at least some part of the product uniquely built to their individual specifications. At the same time, the end consumer has no input into the overall design of the product, which remains fixed within the design parameters established by the firm. The MTO supply chain delivers customised, relatively expensive products that are specifically built to meet the needs of individual customers, although the actual design specifications have previously been established. These products are low-volume and high-margin products (Stavrulaki & Davis 2010:138).

Customisation in these products usually consists of a combination of standardised modular components and additional elements that are specifically produced to meet individual customer requirements. Some MTO supply chains are highly automated and use flexible manufacturing equipment, while others are more labour intensive. In MTO supply chains, forecasting is primarily done for raw materials and standardised components. The raw material and components may be on hand to ensure quick customisation, but actual production does not begin until the customer's order is received, a characteristic typical of a pure pull processes. According to Gunasekaran and Ngai (2005:425), MTO supply chains can have longer lead times than CTO supply chains because components and parts may not be as readily available to assemble the final product (Jonsson 2008:153).

Because of the relatively low volumes and high profit margins associated with MTO products, firms here focus primarily on attracting and maintaining new customers, ensuring customer satisfaction by producing a high quality, customised product, and being sufficiently flexible to address the demand uncertainty inherent in this supply chain. Similar to CTO supply chains, MTO supply chains are leagile, only the decoupling point that separates the lean from the agile emphasis is moved upstream to the beginning of the production process where raw materials are processed (Stavrulaki & Davis 2010:139; Bowersox et al 2010:87).

5.3.3.4 Engineer-to-order (ETO) supply chain

The ability to completely customise a product is the key characteristic of the ETO supply chain, resulting in the customer having the greatest amount of input into the finished product

(Jonsson 2008:153). In addition to having unique individual characteristics built into the product, as is done with the MTO process, the ETO process allows customers to design products to meet their unique individual tastes. Products made with the ETO supply chain represent the ultimate in customisation because there are virtually no constraints on the customers with respect to incorporating their individual preferences and requirements into the final design of the product (Stavrulaki & Davis 2010:140).

Such products are by definition low volume (often volumes of one), with highly variable characteristics, and have high prices. Forecasting is hardly done at all in the ETO supply chain because the raw materials are either commodities readily available in the marketplace or must be individually sourced on the basis of the specific needs of the product's final design. The ETO supply chain is usually controlled by the designer and builder, who typically deal directly with the end customer, and lead times tend to be long. ETO supply chains must provide their diverse customers with the highest quality products and service in a highly uncertain environment. Because of their emphasis on responding to uncertain and changing customer needs, agility is the ultimate competitive priority of ETO supply chains. ETO supply chains must maintain highly flexible production and logistics processes to achieve agile capabilities (Stavrulaki & Davis 2010:142).

5.3.3.5 Manufacturing processes in the supply chain (pull and push)

All processes in a supply chain fall into one of two categories: push or pull. In the push process, production of a product is authorised on the basis of forecasting, which is in advance of customer orders (Jonsson 2008:268). In the pull process, however, the final assembly is triggered by customer orders. In a pure push process, make-to-stock is the primary production approach. Demand is forecast on the basis of historical sales data. The need from the end users is satisfied from inventory. Production lead time is relatively long and finished goods inventory is more than that of the pull system. In the pull approach, end users trigger the production process (Chopra & Meindl 2010:70). The major production strategy is make-to-order, assemble-to-order, and build-to-order. In a pull scenario, demand uncertainty is higher and cycle time is shorter than that of the push approach. In this process, finished goods inventory is minimal (Taylor 2004:29). Table 5.5 indicates the alignment between manufacturing characteristics and supply chain strategies.

Table 5.5: Aligning manufacturing characteristics and supply chain strategies

Manufacturing characteristics	Lean supply chain strategy	Agile supply chain strategy
Manufacturing strategies	MTS	CTO, MTO, ETO
Manufacturing cost	Low cost manufacturing strategy	Cost is demand driven (flexibility)
Inventory holding	Minimum inventory in the production process	Hold inventory based on demand specifications (pull by orders)
Changes in manufacturing	Little or no changes (based on projected forecasting)	Make provision for changes in customer demand
Manufacturing process	Push supply	Pull supply

Source: Researcher's own construction

5.3.4 Determining supply chain strategies based on the decision drivers of SCM

There is a basic pattern to the practice of supply chain management. Each supply chain has its own unique set of market demands and operating challenges. Effective supply chain management calls first for an understanding of each driver and how it operates. The supply chain strategies directly affect the supply chain decision drivers. The decision drivers examined in the study include the following: production (facilities); inventory; location; transportation; information; sourcing; pricing; supplier selection; alliances; and relationships.

5.3.4.1 Production

Production refers to the capacity of a supply chain to make and store products. The facilities of production are factories and warehouses (Taylor 2004:21). The fundamental decision that managers face when making production decisions is how to resolve the trade-off between responsiveness and efficiency. If factories and warehouses are built with a lot of excess capacity, they can be extremely flexible and respond quickly to wide swings in product demand. Facilities where all or almost all capacity is being used are not capable of responding easily to fluctuations in demand. However, capacity costs money and excess capacity is idle capacity not in use and not generating revenue. Hence the more excess capacity there is, the less efficient the operation becomes (Hugos 2006:10).

Factories can be built to accommodate one of two approaches to manufacturing, these being product focus and a functional focus. A factory that takes a product focus performs the range of different operations required to make a given product line from the fabrication of different product parts to assembly of these parts. The production process can be made extremely responsive by building factories that have a great deal of excess capacity and that use flexible manufacturing techniques to produce a wide range of items. To be even more responsive, a company can do its production in many smaller plants that are close to major groups of customers so that delivery times are shorter. If efficiency is desirable, then a company can build factories with little excess capacity and have the factories optimised for producing a limited range of items. Further efficiency can be gained by centralising production in large central plants to obtain better economies of scale (Chopra & Meindl 2010:62).

5.3.4.2 Inventory

Production facilities contain controlled quantities of materials called inventories (Taylor 2004:22). Inventory is spread throughout the supply chain and includes everything from raw material to work in process to finished goods that are held by manufacturers, distributors and retailers in a supply chain. Managers must decide where they want to position themselves in the trade-off between responsiveness and efficiency (Nel & Badenhorst-Weiss 2010:210). Holding large amounts of inventory allows a company or an entire supply chain to be extremely responsive to fluctuations in customer demand (Bowersox et al 2010:157). However, the creation and storage of inventory are a cost, and to achieve high levels of efficiency, the cost of inventory should be kept as low as possible. An organisation can be responsive by stocking high levels of inventory for a wide range of products. Additional responsiveness can be gained by stocking products at many locations in order to have the inventory close to customers and available to them immediately. Efficiency in inventory management calls for reducing the inventory levels of all items and especially of items that do not sell as frequently. Also, economies of scale and cost savings can be obtained by stocking inventory in only a few central locations (Chopra & Meindl 2010:65).

5.3.4.3 Location

Location refers to the geographical placement of supply chain facilities (Jonsson 2008:53). It also includes the decisions relating to which activities should be performed in each facility. The responsiveness versus efficiency trade-off here is the decision whether to centralise activities in fewer locations to gain economies of scale and efficiency, or to decentralise activities in many locations close to customers and suppliers in order for operations to be more responsive. When making location decisions, managers need to consider a range of factors relating to a given location, including the cost of facilities, the cost of labour, skills available in the workforce, infrastructure conditions, taxes and tariffs, and proximity to suppliers and customers. Location decisions tend to be strategic decisions because they commit large amounts of money to long-term plans (Waters 2003:105). Location decisions have a strong impact on the cost and performance characteristics of a supply chain. Once the size, number and location of facilities are determined, this also defines the number of possible paths through which products can flow on the way to the final customer. Location decisions reflect a company's basic strategy for building and delivering its products to market. A location approach that emphasises responsiveness would be one where a company opens up many locations to be physically close to its customer base. Efficiency can be achieved by operating from only a few locations and centralising activities in common locations (Chopra & Meindl 2010:63).

5.3.4.4 Transportation

This refers to the movement of everything from raw material to finished goods between different facilities in a supply chain (Jonsson 2008:63). In transportation, the trade-off between responsiveness and efficiency is manifested in the choice of transport mode (Taylor 2004:23). Fast modes of transportation such as aeroplanes are highly responsive, but also more costly. Slower modes such as ship and rail are extremely cost efficient but not as responsive. Since transportation costs can be as much as a third of the operating cost of a supply chain, decisions made here are crucial. There are six basic modes of transport that a company can choose from (Jonsson 2008:64):

- A ship is highly cost efficient but also the slowest mode of transport. It is limited to use between locations situated next to navigable waterways and facilities such as harbours and canals.
- Rail is also extremely cost efficient but can be slow. This mode is also restricted to use between locations that are served by railway lines.
- Pipelines can be extremely efficient but are restricted to commodities that are liquids or gases such as water, oil and natural gas.
- Trucks are a relatively quick and highly flexible mode of transport. Trucks can go almost anywhere. However, the cost of this mode is prone to fluctuations because the cost of fuel fluctuates and the condition of roads varies.
- Airplanes are an extremely fast mode of transportation and are responsive. This is also the most expensive mode, but is somewhat limited by the availability of appropriate airport facilities.

- Electronic transport is the fastest mode of transport and it is highly flexible and cost efficient. However, it can only be used for movement of certain types of products such as electric energy, data and products composed of data such as music, pictures and text.

According to Chopra and Meindl (2010:65), responsiveness can be achieved by a transportation mode that is fast and flexible. Many companies that sell products through catalogues or over the internet are able to provide high levels of responsiveness by using transportation to deliver their products, often within 24 hours. Efficiency can be emphasised by transporting products in larger batches and doing it less often. The use of transportation modes such as ship, rail and pipelines can be most efficient. Transportation can be made more efficient if it is originated out of a central hub facility instead of from many branch locations (Nel & Badenhorst-Weiss 2010:211).

5.3.4.5 Information

Information is the basis upon which to make decisions about the other four supply chain drivers. It is the connection between all of the activities and operations in a supply chain. To the extent that this connection is a strong one (ie the data are accurate, timely and complete), the companies in a supply chain will each be able to make sound decisions for their own operations (Jonsson 2008:90). This will also tend to maximise the profitability of the supply chain as a whole. That is the way that stock markets or other free markets work, and supply chains have many of the same dynamics as markets. The power of this driver grows stronger each year as the technology for collecting and sharing information becomes more widespread, easier to use and less expensive. Information, much like money, is a useful commodity because it can be applied directly to enhance the performance of the other four supply chain drivers. High levels of responsiveness can be achieved when companies collect and share accurate and timely data generated by the operations of the other four drivers (Nel & Badenhorst-Weiss 2010:211).

5.3.4.6 Sourcing

Sourcing is the set of business processes required to purchase goods and services (Hines 2006:177). Managers must first decide which tasks will be outsourced and those which will be performed inside the firm. For each task, the manager must decide whether to source from a single supplier or a portfolio of suppliers. If a portfolio of multiple suppliers is to be carried, then the role of each supplier in the portfolio must be clarified. The next step is to identify the set of criteria that will be used to select suppliers and measure their performance (Jonsson 2008:164). Managers then select suppliers and negotiate contracts with them (Chopra & Meindl 2010:72). Sourcing decisions are crucial because they affect the level of efficiency and responsiveness the supply chain can achieve. Outsourcing certain processes to other parties may increase a supply chain's efficiency, but may reduce its responsiveness because of possible longer lead time to achieve economies of scale (Nel & Badenhorst-Weiss 2010:211). However, responsiveness can be increased by gaining state-of-the-art products. Outsourcing decisions should be driven by the desire for growth in total supply chain surplus (Chopra & Meindl 2010:73).

5.3.4.7 Pricing

Pricing is the process whereby a firm decides how much to charge customers for its goods and services. Pricing affects the customer segments that choose to buy the product, as well as customer expectations. This directly affects the supply chain in terms of the level of responsiveness required as well as the demand profile that the supply chain attempts to serve (Chopra & Meindl 2010:74). Pricing is a significant attribute through which a firm executes its competitive strategy. Customers expect low prices but are comfortable with a lower level of product availability. Steady prices also ensure that demand stays relatively stable. Pricing therefore affects the behaviour of the buyer of the product, thus affecting supply chain performance. Customers who value responsiveness will pay more for higher levels of customer service (Nel & Badenhorst-Weiss 2010:211). Table 5.6 indicates the alignment of the decision drivers and supply chain strategies.

Table 5.6: Determining supply chain strategies based on the decision drivers

Decision drivers	**Efficiency (lean supply chain)**	**Responsiveness (agile supply chain)**
Production	• Little excess capacity • Narrow focus • Few central plants	• Excess capacity • Flexible manufacturing • Many small factories
Inventory	• Low inventory levels • Fewer items	• High inventory levels • Wide range of items
Location	• Few central locations serve wide areas	• Many locations close to customers
Transportation	• Shipments few, large • Slow, cheaper modes	• Frequent shipments • Fast and flexible mode
Information	• Information is used to build master production schedule (forecasts) and creates delivery due dates • Cost of information decreases while other costs rise	• Information is used on actual demand to be transmitted quickly to reflect real demand accuracy • Collect and share timely, accurate data
Sourcing	• Supplier selection criteria based on low prices	• Supplier selection criteria based on high service levels
Pricing	• Pricing is a key means for balancing supply and demand • Based on low margins and high volumes	• Pricing does not normally impact on short-term demand • Based on high margins

Source: Researcher's own construction

Table 5.7 summarises the instruments for determining practices of lean and agile supply chains based on product characteristics, manufacturing characteristics and decision drivers of SCM.

Table 5.7: Instrument for determining supply chain strategies

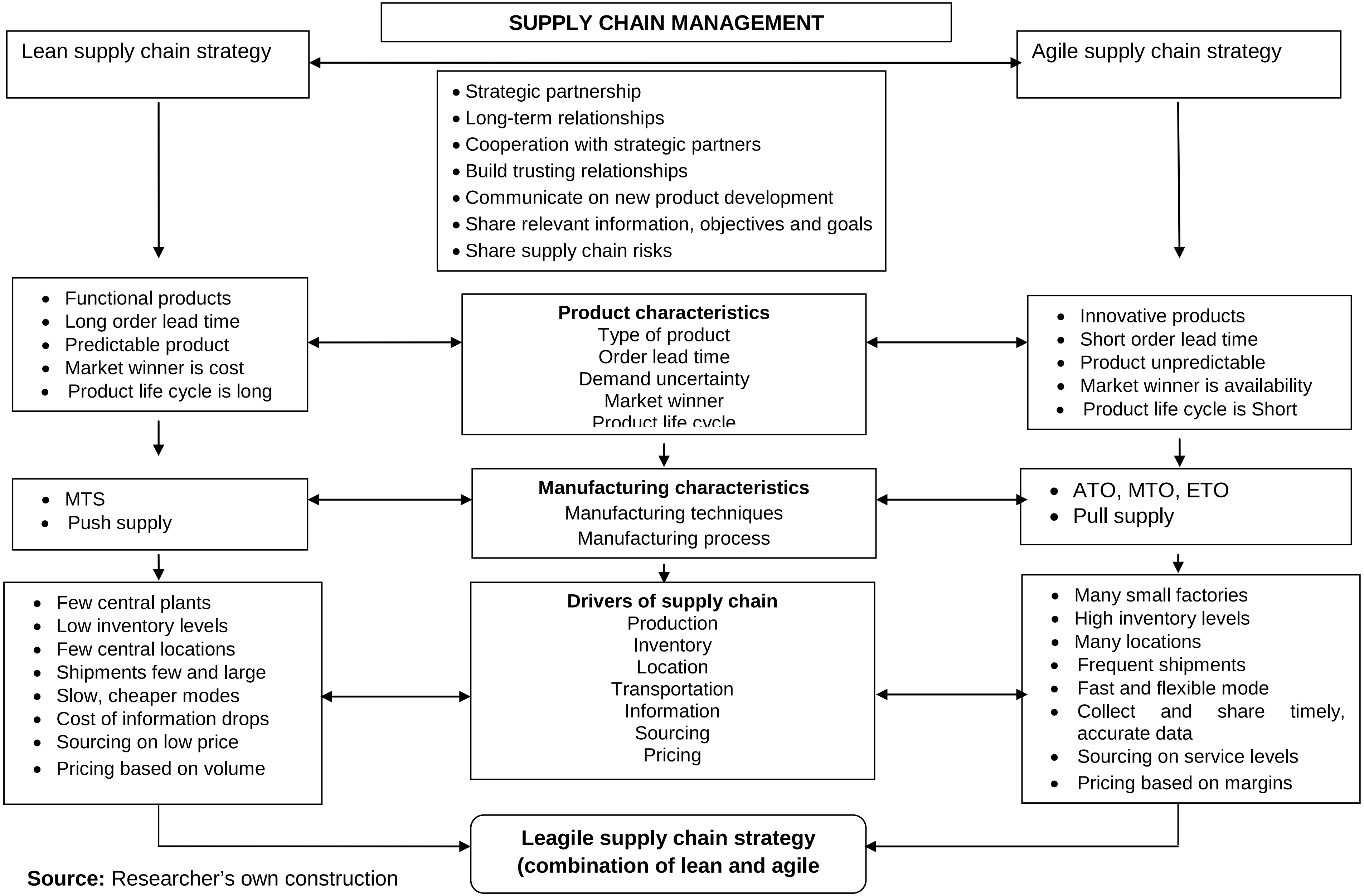
Supply chain instrument	Elements of supply chain instrument	Lean supply chain	Agile supply chain
Product characteristics	Type of product	• Functional products	• Innovative products
	Order lead time	• Long order lead time	• Short order lead time
	Demand uncertainty	• Predictable product	• Product unpredictable
	Market winner	• Cost	• Availability
	Product life cycle	• Long	• Short
	Product variety	• Low	• High
Manufacturing characteristics	Product	• Standard (functional)	• Customised (innovative)
	Manufacturing strategies	• MTS	• ATO, MTO, ETO
	Manufacturing process	• Push supply	• Pull supply
Decision drivers of the supply chain	Production	• Little excess capacity • Narrow focus • Few central plants	• Excess capacity • Flexible manufacturing • Many small factories
	Inventory	• Low inventory levels • Fewer items	• High inventory levels • Wide range of items
	Location	• Few central locations serve wide areas	• Many locations close to customers
	Transportation	• Shipments few, large • Slow, cheaper modes	• Frequent shipments • Fast and flexible mode
	Information	• Cost of information declines while other costs rise	• Collect and share timely, accurate data
	Sourcing	• Supplier selection criteria based on low prices	• Supplier selection criteria based on high service levels
	Pricing	• Pricing is a key means for balancing supply and demand • Based on low margins and high volumes	• Pricing does not normally impact on short-term demand • Based on high margins

Source: Researcher's own construction

5.3.5 Conceptual framework for supply chain practices and strategies

From the above discussions, it is obvious that for proper implementation of SCM, an appropriate supply chain strategy needs to be chosen to satisfy the end customer. This is because "one size does not fit all". Supply chain practices such as partnerships, long-term relationships, cooperation, collaboration, information sharing, trust, shared technology and a fundamental shift away from managing individual functional processes to managing integrated chains of processes are critical (Power 2005: 253), are enablers for competitive advantage and enhance the supply chain performance. Proper implementation of the practices will create a competitive advantage built upon a well-planned and executed SCM strategy that is sustainable (Iskanius 2006: 78). Also, shared information and trust between partners is particularly vital for implementing the optimal supply chain strategy. Two generic supply chain strategies are lean and agile supply chain strategies. An organisation can employ lean (efficient), agile (responsive) or a combination of lean and agile supply chain (leagile). Figure 5.8 illustrates a conceptual framework for supply chain practices and strategies.

Figure 5.8: Conceptual framework for supply chain practices and strategies



Source: Researcher's own construction

5.4 CHAPTER SUMMARY

The chapter dealt with the instruments for determining supply chain strategies and practices. The chapter provided a brief overview of SCM, supply chains, SCM activities, drivers of SCM and factors for determining supply chain strategies. The chapter revealed that there are two generic strategies in the supply chain, namely lean (efficient) and agile (responsive) supply chain strategies. The combination of the features of lean and agile supply chains leads to a third strategy known as leagile supply chain (leanness + agility). Three supply chain characteristics for determining supply chain strategies identified in the chapter are product characteristics, manufacturing characteristics and the decision drivers of supply chain. Also, the chapter further articulated that practices in supply chain are determined by the supply chain strategy. A supply chain practice is therefore geared towards lean, agile or leagile supply chain. The next chapter focuses on the research design and methodology.

CHAPTER 6

RESEARCH DESIGN AND METHODOLOGY

6.1 INTRODUCTION

The previous chapters presented the theoretical framework for SCM, the overview of the global and South African automotive industry and supply chain practices and challenges; and a framework for determining supply chain strategies. These chapters served the purpose of justifying the study and defining the research problem and objectives. In this chapter, the research design and methodology are presented. Research design and methodology direct a researcher in planning and implementing a study in a way that is most likely to achieve the intended outcome, and provide the blueprint for conducting the research. Research is about enquiry, about a systematic investigation to find out things to solve problems (McGivern 2006:4). The chapter deals with the research design, demarcation of the population, specific sampling procedure, data collection and procedure for measurement of the research evaluation framework, testing of the research evaluation framework and the method of data analysis that was employed in the study.

6.2 THE RESEARCH PHILOSOPHY

Research philosophy relates to the development of knowledge and the nature of the knowledge (Saunders, Lewis & Thornhill 2007). It involves the basic beliefs about how the world will be reflected in the way the research is designed, how the data are collected and analysed, and even the way in which the findings are presented. It is important to recognise and understand the personal paradigm because this determines the entire course of the research study undertaken (Collis & Hussey 2003). The term “paradigm” refers to the progress of scientific practice based on people’s philosophies and assumptions about the world and the nature of knowledge (Collis & Hussey 2003).

Collis and Hussey (2003), Remenyi, Williams, Money and Swartz (2003), Esterby-Smith, Thorpe and Lowe (2003) and Sobh and Perry (2006) acknowledge that two contrasting views on how research should be conducted can be labelled as positivism and social constructionism/phenomenology. The key idea of positivism is that the social world exists externally, and that its properties should be measured through objective methods, instead of being inferred subjectively through sensation, reflection or intuition (Esterby-Smith et al

2003). The positivist philosophical stance assumes that the researcher is independent of and neither affects nor is affected by the subject of the research (Remenyi et al 2003). Unlike the positivist, the phenomenologist does not consider the world to consist of an objective reality, but focuses instead primarily on subjective consciousness. The phenomenological paradigm thus assumes that reality is not objective or external but is socially constructed and given meaning by people (Esterby-Smith et al 2003; Sobh & Perry 2006). There are three major ways of thinking about research philosophy (Sobh & Perry 2006; Saunders at al 2007). These include ontology, epistemology and axiology. Ontological, epistemological and axiological assumptions are concerned with the nature of reality, acceptable knowledge in the field of study and values, respectively. These three assumptions helped to position this study within the philosophical continuum.

6.2.1 Ontology

In the ontological assumption, the researcher must decide whether to consider that the world is objective and external to the researcher or is socially constructed and only understood by examining the perceptions of human actors (Collis & Hussey 2003). The first element is objectivism or realism, and the second, subjectivism or nominalism (Johnson & Duberley 2000; Saunders at al 2007). As noted by Sobh and Perry (2006) objectivism portrays the position that social entities exist in a reality external to social actors concern with existence. Subjectivism holds that social phenomena are created from the perceptions and subsequent actions of those social actors' concern for their existence. Within these two extremes, this study was positioned more towards subjectivism. The study did not adopt the extreme subjectivist view where there may be no social world apart from that which is inside the individual's mind (Collis & Hussey 2003). This is because it portrays and explores perceptions about SCM practices and strategies of the automotive industry in South Africa.

6.2.2 Epistemology

Epistemology involves an examination of the relationship between the researcher and that which is being researched. On one hand, as a positivist the researcher works with an observable and measurable social reality by adopting an independent and objective stance. The positivist assumes that there is a reality that exists independently of the observer and the job of the researcher is merely to find out this pre-existing reality. The social constructionist viewpoint, on the other hand, does not assume any pre-existing reality and the aim of the researcher is to understand how people invent structures to help them make sense of what is going on around them (Esterby-Smith et al 2003). This study adopted a constructivism viewpoint and that its aim was determine supply chain best practices and strategies in the South African automotive industry from in-depth studies of light vehicle manufacturers.

6.2.3 Axiology

Axiology is a branch of philosophy that studies judgement about value (Sobh & Perry 2006). In axiological assumptions, positivists believe that science and the process of research are value free, and that the objects they are studying are unaffected by their research activities (Collis & Hussey 2003; Barzi 2009). These assumptions are less convincing in social sciences research which is concerned with the activities and behaviour of people. Thus at the other extreme, phenomenologists consider that researchers have values which help to determine what are recognised as facts and the interpretations drawn from them. The understanding about axiology positions this research closer to the value-laden end because the researcher is involved with what is being researched and the researcher's own values play a role in all stages of the research process.

Essentially, as stated by Sobh and Perry (2006), antology is "reality", epistematology is the relationship between the reality and the researcher and the methodology is the technique used by the research to discover that reality. According to Barzi (2009), no one research philosophy is better than another. Which research philosophy is "better" depends on the research question(s) the researcher seeks to answer. Table 6.1 illustrates four scientific paradigms.

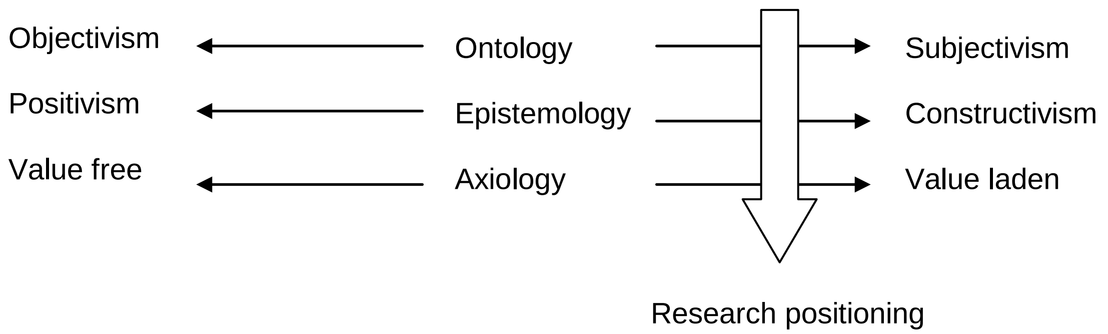
Table 6.1: Four scientific paradigms

Element	Paradigms			
	Positivism	Constructivism	Critical theory	Realism
Ontology	Reality is real and apprehensible	Multiple local and specific "constructed" realities	"Virtual" reality shaped by social, economic, ethnic, political, cultural, and gender values, crystallised over time	Reality is "real" but only imperfectly and probabilistically apprehensible and so triangulation from many sources is required to try to know it
Epistemology	Findings true – researcher is objective by viewing reality through a "one-way mirror"	Created findings – researcher is a "passionate participant" in the world being investigated	Value mediated findings – researcher is a "transformative intellectual" who changes the social world within which participants live	Findings probably true – researcher is value-aware and needs to triangulate any perceptions he or she is collecting
Common methodologies	Mostly concerned with testing theory. Thus mainly quantitative methods such as survey, experiments and verification of hypotheses	In-depth unstructured interviews, participant observation, action research and grounded theory research	Action research and participant observation	Mainly qualitative methods such as case studies and convergent interviews

Source: Adapted from Sobh & Perry (2006:1195)

An in-depth understanding of the automotive industry is required to achieve the expected goal as well as the involvement of the researcher. Hence the philosophical approach of this study is a mixture of subjectivism and constructivism and it is value laden. Based on the foregoing discussion, the positioning of the philosophical continuum within ontology, epistemology and axiology is indicated in figure 6.1.

Figure 6.1: Positioning the research within the philosophical continuum



6.3 STATEMENT OF THE PROBLEM AND RESEARCH OBJECTIVES

6.3.1 Statement of the problem

As indicated in chapter 1, section 1.6, the statement of the problem can be reflected in the main research question which was formulated as follows: Do local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies?

In an endeavour to answer the main research question, the following secondary questions were answered:

- What is the extent to which supply chain best practices are implemented by local manufacturers of light vehicles in South Africa?
- What are the supply chain challenges faced by local manufacturers of light vehicles in South Africa?
- What is (are) the most important key supply chain performance indicators for optimising the supply chain performance of local manufacturers of light vehicles in South Africa?
- What is the supply chain strategy of local manufacturers of light vehicles based on product line characteristics?
- What is the supply chain strategy of local manufacturers of light vehicles based on manufacturing characteristics?
- What is the supply chain strategy of local manufacturers of light vehicles based on the decision drivers of SCM?
- Is there a difference with reference to supply chain practices and strategies between manufacturers of different parent company origin in South Africa?

6.3.2 Research objectives

The main aim of the study was *"to determine whether local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies."*

The sub-objectives were as follows:

- To determine the extent to which supply chain best practices of local manufacturers of light vehicles in South Africa are implemented
- To determine the supply chain challenges faced by local manufacturers of light vehicles in South Africa

- To determine the key supply chain performance indicators most important in contributing to optimising the supply chain performance of local manufacturers of light vehicles in South Africa
- To determine supply chain strategies of locally manufactured light vehicles based on product line characteristics
- To determine supply chain strategies of locally manufactured light vehicles based on manufacturing characteristics
- To determine supply chain strategies of locally manufactured light vehicles based on decision drivers of SCM
- To determine the differences with reference to supply chain practices and strategies between manufacturers of different origin (parent companies)
- To develop a conceptual framework for determining supply chain best practices in line with a chosen strategy that could guide supply chain managers (locally manufactured light vehicles) in the automotive industry in South Africa in their decision making

6.4 RESEARCH DESIGN

Research design is the framework or blueprint for conducting a marketing research process that guides the collection and analysis of data (Malhotra 2004:74). It specifies the procedures for conducting and obtaining information needed to structure and or solve research problems. In designing a research study, a significant decision is the choice of the research design because it specifies how information will be obtained. As noted by Tustin, Lightelm, Martins and Van Wyk (2005:83), there are three main types of research design, namely exploratory, descriptive and explanatory or causal research designs, as explained below.

6.4.1 Exploratory research design

Exploratory research is a design in which the major emphasis is on gaining ideas and insights. It is particularly helpful in breaking broad, vague problem statements into smaller, more precise sub-problem statements. It is conducted for a research problem or issue when there are few or no earlier studies to which a study can be linked. It is characterised by flexibility and versatility with respect to the methods used and rarely involves structured questionnaires, large samples or probabilistic sampling plans (Malhotra 2004:77). The design method is used to search for insights into the general nature of a problem. Literature reviews and individual group unstructured interviews are examples of the exploratory research design. According to Cooper and Schindler (2003), this design is suitable when the researcher lacks a clear idea of the problems to be encountered during the study. It is useful for establishing priorities among research questions, learning about practical issues to search for patterns and ideas and contributes to the formation of the problem statement (McGivern 2006:53). In this study, exploratory research design was employed and it contributed to the formation of the problem statement and research objectives (literature study).

6.4.2 Descriptive research design

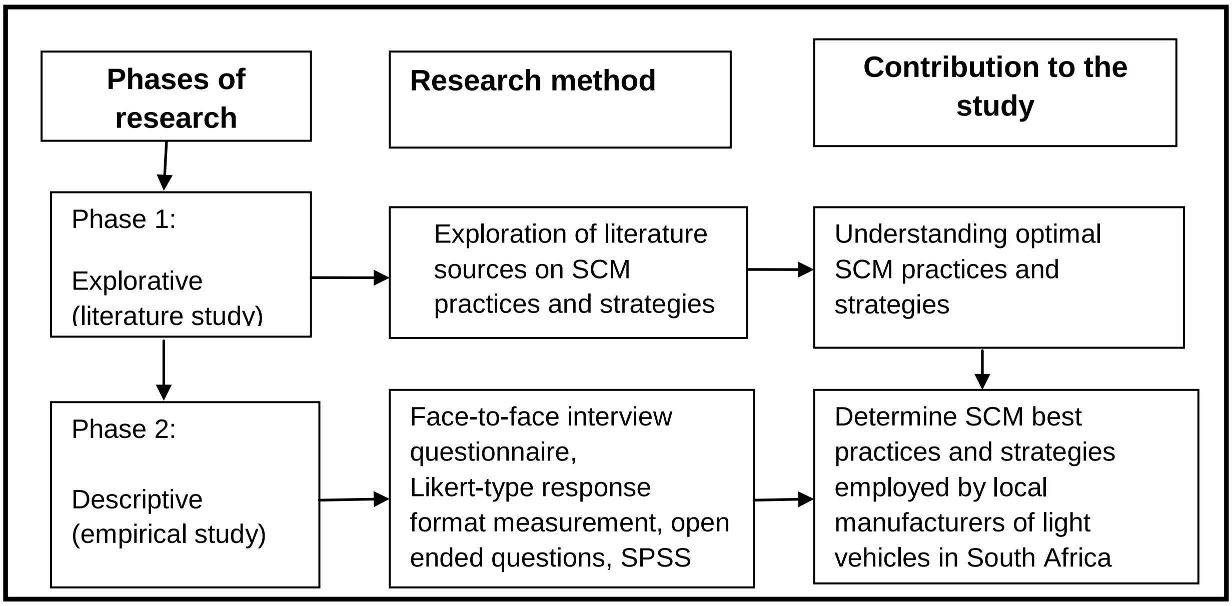
Descriptive research is the design in which the major emphasis is on determining the frequency with which something occurs or the extent to which two variables co-vary. It attempts to find answers to the questions “who, what, when and where” (McGivern 2006:53). It has a broad appeal to the administrator and policy analyst for planning, monitoring and evaluating. According to Cooper and Schindler (2003), descriptive research is more formalised, typically structured with clearly stated hypotheses or investigative questions. Hence it is marked by a clear statement of the problem and specific hypotheses or alternatively an unproven statement and detailed information needed (Malhotra 2004:79). In descriptive research, it is important to know the underlying relationships of the problem area. It uses empirical analysis to answer questions. There are two types of descriptive research designs, namely longitudinal and cross-sectional studies. Longitudinal studies are investigations involving a fixed sample of elements that are measured repeatedly through time, while cross-sectional studies involve a sample of elements selected from the population of interest which are measured at a single point in time (McGivern 2006:99). This study employed a cross-sectional study of automotive manufacturers in South Africa. The second phase of the study (empirical study) constitutes the descriptive research design.

6.4.3 Explanatory/causal research design

Causal research is the design in which the major emphasis is on determining cause-and-effect relationships. It involves obtaining evidence of cause-and-effect (causal) relationships. Causal research, like the descriptive research design, requires a planned and structured design. According to Malhotra (2004:85), the main methods of causal research are experimentation.

In this study a combination of exploratory and descriptive research design was employed. The exploratory research was conducted in the first phase of the study (towards the formulation of the problem statement and research questions that guide the study) while the second phase of the study was descriptive. The phases of the research design are illustrated in figure 6.2.

Figure 6.2: Phases of the research design for the study



Source: Researcher's own construction

6.4.4 The research approach

Research can be conducted in different ways and includes both theoretical and methodological approaches. The theoretical approach can either be inductive or deductive, while the methodological approach can either be qualitative or quantitative.

6.4.4.1 Inductive versus deductive research

An inductive approach implies that general conclusions are drawn from empirical findings, and can be described as the logical process of establishing a general proposition on the basis of observation of particular facts. The empirical material is first studied and then connected to the theory. In deductive research, already established theories and literatures are used as the foundation for the research (Saunders et al 2007). Several hypotheses are constituted from the existing and then tested in reality. Saunders et al (2007) acknowledge that deductive research owes more to positivism, while inductive research owes more to the interpretive (constructivism). Table 6.2 indicates attributes of the deductive and inductive research approaches.

Table 6.2: Deductive and inductive research approaches

Deductive	**Inductive**
• Scientific principles • Moving from theory to data • Need to explain causal relationships between variables • Collection of quantitative data • Application of controls to ensure validity of data • Operationalisation of concepts to ensure clarity of definition • Highly structured approach • Researcher independent of what is being researched • Necessity to select samples of sufficient size in order to generalise conclusions	• Gaining an understanding of the meanings humans attach to events • Close understanding of the research context • Collection of qualitative data • More flexible to permit changes of research emphasis as the research progresses • Realisation that the researcher is part of the research process • Less concern with the need to generalise

Source: Adapted from Saunders et al (2003); Salehi (2010:53)

This study is both deductive and inductive. This is because (1) conclusions were drawn from the empirical findings and compared with existing theories (literature) in the research area, (2) qualitative data were obtained from unstructured questions; and (3) the researcher was independent of the research process.

6.4.4.2 Qualitative and quantitative research

According to Gray et al (2007:42), there are two distinctive approaches or methods to research. These are the quantitative and qualitative approaches. The qualitative approach implies an emphasis on processes and meanings that are not measured in terms of quantity, amount, intensity or frequency. The qualitative approach provides a deeper understanding of the phenomenon within its context. Moreover, qualitative researchers stress the socially constructed nature of reality that states the relationship between the researcher and the phenomenon under investigation. However, quantitative research emphasises the measurement and analysis of causal relationships between variables, not processes (McGivern 2006:58).

McGivern (2006:57), maintains that the distinction between qualitative and quantitative approaches depends primarily on the following two factors: (1) the state of our knowledge of a particular research topic; and (2) the researcher's assessment of the nature of the phenomenon being studied. According to Sullivan (2001), when there is little theoretical support for a phenomenon, it may be impossible to develop precise hypotheses, research questions or operational definitions. In such cases, qualitative research is appropriate because it may be more exploratory.

Characteristics of qualitative studies are that they are based largely on the researcher's own description, emotions and reactions (Yin 2003). The qualitative approach also includes closeness to the respondents or to the source from which the data are being collected. It is characterised by gathering abundant information to investigate several variables from a few numbers of entities. In order to gather high-quality data, the most commonly used method is case studies and interviews where no set answering alternatives are offered (Tustin et al 2005). Table 6.3 below provides a summary of the differences between quantitative and qualitative research.

Table 6.3: Differences between quantitative and qualitative research

Topic	Quantitative research	Qualitative research
Research enquiry	Exploratory, descriptive and explanatory	Exploratory, descriptive and explanatory
Nature of questions and responses	Who, what, when, where, why and how many Relatively superficial and rational responses Measurement, testing and validation	What, when, where, why Below the surface and emotional responses Exploration, understanding and idea generation
Sampling approach	Probability and non-probability methods	Nonprobability methods (purposive)
Sampling size	Relatively large	Relatively small
Data collection	Not very flexible Interviews and observation Standardised Structured More closed questions	Flexible Interviews and observation Less standardised Less structured More open-ended and nondirective questions
Data	Numbers, percentages, means Less detail or depth Nomothetic description Context poor High reliability, low validity Statistical inference possible	Words, pictures, diagrams Detailed and in-depth Ideographic description Context rich High validity, low reliability Statistical inference not possible
Cost	Relatively low cost per respondent Relatively high cost project	Relatively high cost per respondent Relatively low cost project

Source: Adapted from McGivern (2006:57)

Jankowicz (2005:225) and Cooper and Schindler (2006:219) contend that several qualitative methods or quantitative methods may be combined in the same research project. Furthermore, according to Yin (2003), the best research method to be useful for a study depends on the research study purpose and accompanying research questions. Owing to the nature of the research questions and the above discussions, both research methods were used in this study - hence triangulation. Triangulation was achieved by using structured interview questions (quantitative), while in some sections, the respondents were required to justify their responses (qualitative).

6.5 RESEARCH STRATEGY

A vital step in research design is the choice of the research strategy for collecting data. A research strategy is a road map, that is, an overall plan for undertaking a systematic exploration of the phenomenon of interest (Remenyi et al 2003). Many possible strategies are available to a researcher. There are five main research strategies. These include experiments, surveys, histories, analysis of archival information and case studies. Each of these strategies is a different way of collecting and analysing empirical evidence. As a rule, case studies are considered appropriate for the exploratory phase, while surveys and histories fit the descriptive phase, and experiments are the only way of conducting explanatory or causal inquiries. However, this hierarchical view is incorrect and each strategy can be used for all three purposes: exploratory, descriptive or explanatory. Yin (2003) distinguishes strategies on the basis of three conditions (table 6.4). These include the type of research questions posed; the extent of control an investigator has over actual behavioral events; and the degree of focus on contemporary as opposed to historical events.

Table 6.4: Relevant situations for different research strategies

Strategy	**Form of research questions**	**Required control over behavioural events**	**Focuses on contemporary events**
Experiments	How and why	Yes	Yes
Surveys	Who, what, where, how many and how much	No	Yes
Archival analysis	Who, what, where, how many and how much	No	Yes/No
History	How and why	No	No
Case study	How and why	No	Yes

Source: Adapted from McGivern (2006:110)

Research questions are considered the first and most important condition for differentiating between different strategies (Saunders et al 2007). "What", "who", and "where" questions and their derivatives – "how many" and "how much" – are likely to favour survey and archival records, while "how" and "why" questions lead to case studies, histories and experiments as the preferred research strategies. In addition to the type of research question, "extent of control over behavioral events" and "degree of focus on contemporary as opposed to historical events" differentiates between various strategies. While experiment is the only strategy that requires control over events, history is the strategy that does not deal with contemporary events. Case studies are appropriate for examining contemporary events when the relevant behaviours cannot be manipulated.

In this study, a survey was used to determine SCM practices and strategies among automotive manufacturers in South Africa. Survey is a form of research where the researcher interacts with the respondents to obtain facts, opinions and attitudes (McDaniel & Gates 2001:30). In survey research, a sample is interviewed in some form or the behaviour of respondents is observed and described in some way (Zikmund et al 2010:67). A survey was thus deemed the appropriate method for conducting research into determining optimal SCM practices and strategies.

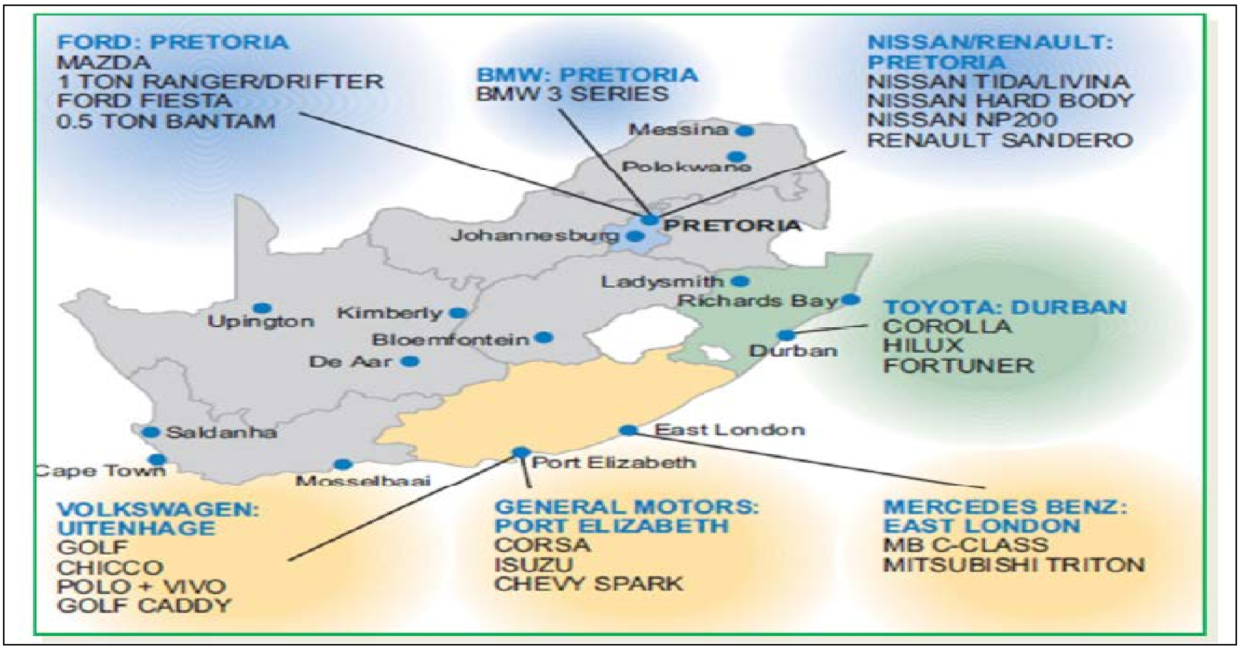
6.6 POPULATION AND SAMPLE

A population is any precise defined set of people or collection of items which is under consideration (Gray et al 2007:103). It is an aggregate of all the elements that share a common set of characteristics and that comprise the universe for the purpose of a research process, while sampling is a subsection of a population and should represent the interest of the study (Gray et al 2007:103). The basic idea of sampling is that by selecting some of the elements in a population, conclusions may be drawn about the entire population. The validity of the sample depends on accuracy and precision.

6.6.1 Population of the study

The target population for the study was locally manufactured (assembled) light vehicle manufacturers (original equipment manufacturers (OEMs)) in the South African automobile industry (total target population). Major international assemblers and manufacturers have established operations in South Africa, including OEMs from traditional manufacturing powerhouses in the USA, Japan and Europe, where key decisions about their manufacturing is made. Most of the global motor vehicle branded manufacturers are represented in South Africa. These include Toyota, BMW, Volkswagen, DaimlerChrysler, Nissan, General Motors, Ford (incorporating Mazda, Land Rover and Volvo) and Fiat. Some of the OEMs manufacture certain models locally for the local market and also export some of their production outputs. These manufacturers are the focus of this study. Fiat, currently does not assemble vehicles in South Africa - hence there are seven automotive manufacturers. These automotive manufacturer operations are concentrated in four South African cities: Pretoria, Durban, East London, and Port Elizabeth (Alfaro et al 2012:15). Toyota is the major producer (in terms of market share) of both cars and light commercial vehicles. Figure 6.3 indicates the OEMs in South Africa, and their location (Muller 2009:2).

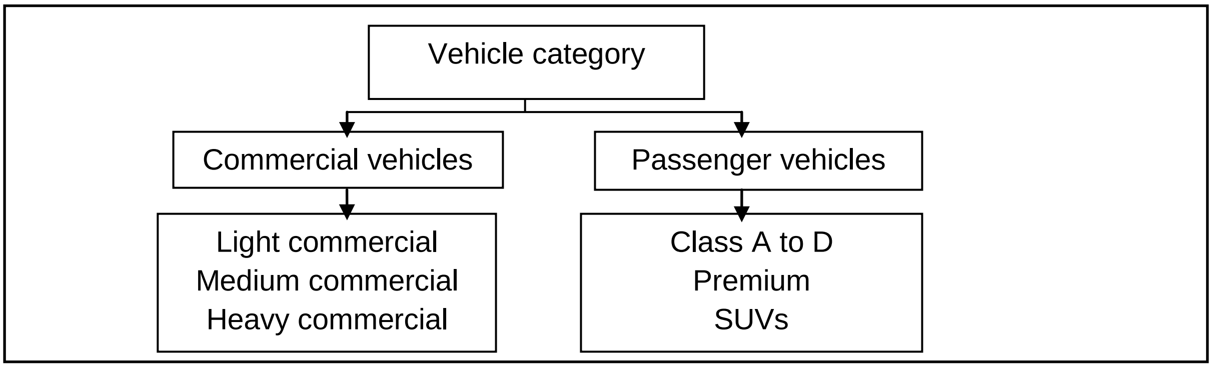
Figure 6.3: Location of assembly plants for OEMs in South Africa



Source: Alfaro et al (2012:15)

The South African automotive industry produces two broad categories of vehicles. These are passenger vehicles and commercial vehicles. Passenger vehicles are classified from A to D class, premium and SUVs, while commercial vehicles are categorised into light commercial, medium commercial and heavy commercial. Passenger vehicle and light commercial vehicles are termed light vehicles. Table 6.5 indicates the classification of vehicles in South Africa.

Table 6.5: Classification of vehicles used in South Africa



Source: Researcher's own construction

One manufacturer may have various production lines with various supply chain strategies for each one. This is because supply chain strategies are unique to a production line and not the supply chain in general as indicated by Fisher (1997). This study focused on one production line (models) for each of the manufacturers. The population for the study therefore constituted light vehicle manufacturers (passenger and light commercial vehicles). Light vehicle manufacturers were chosen, firstly, because this would incorporate all the automotive manufacturers in South Africa. Secondly, both categories of vehicle are used for personal purposes and therefore require distinctive features and characteristics. Table 6.6 presents the various models of passenger and light commercial vehicles assembled in South Africa.

Table 6.6: Light vehicle manufacturers and local manufactured models in South Africa, 2011

Passenger vehicles (2011)		**Light commercial (2011)**	
Manufacturer	**Models**	**Manufacturers**	**Models**
BMW	3-series, 4-door	Nissan	Hardbody, NP300, NP200
Mercedes-Benz	C-Class 4-door	Toyota	Hilux
Nissan	Tiida, Livina/Grand Livina	Ford	Bantam and Rangers
Toyota	Corolla 4-door and Fortuner	General Motors	Chev Utility and Isuzu KB
Ford	Icon and Focus	Mercedes-Benz	Mitsubishi Triton

Source: AIEC (2012)

The study included the following light vehicle manufacturers: BMW, Toyota, Nissan, Mercedes-Benz, Volkswagen and General Motors. Ford Motors South Africa was not part of the study as the company did not agree to participate.

6.6.2 Sampling

Sampling techniques are broadly classified as probabilistic and non-probabilistic sampling (Malhotra 2004:320). Non-probabilistic sampling relies on the personal judgment of the researcher rather than chance to select samples. Probabilistic sampling is a procedure in which elements of the population have a fixed probability of being selected for the sample. The basic idea of sampling is to select some of the elements of the population so that conclusions can be drawn (Cooper & Schindler 2001:163). It is guided by the research questions and conceptual framework. Because the study required in-depth understanding of SCM practices and strategies, random sampling could not be used. The desired sampling method for the study was thus the purposive sampling technique (Gray et al 2007:103). In this sampling technique, a researcher stipulates certain important criteria to be used or waits to be informed of the setting for the sample (Babbie & Mouton 2007:287). Since the study required an in-depth understanding of SCM practices and strategies, expert knowledge was required. The basic criteria used for choosing the respondents was, firstly, the company which was a local manufacturer of light vehicles in South Africa, and secondly, the respondent was an employee at a senior SCM position in that light vehicle manufacturing company. The respondents therefore included general managers: supply chain management; chief executive officers (CEOs); supply chain managers; production managers; operations managers; logistics managers; general managers; and demand management. In some companies, more than one respondent had to participate in the interview process to complete different parts of the questionnaire.

6.6.3 Brief description of light vehicle manufacturers

A short description of the six light vehicle manufacturers used in the study is provided below.

6.6.3.1 BMW

BMW South Africa produces motor vehicles mainly for the exclusive buyer from its Rosslyn plant, north of Pretoria. This is a world-class plant capable of producing customised cars for discerning customers across the globe. A large proportion of the vehicles produced are exported to BMW markets in other countries. The company recognises its corporate social responsibility and is committed to investing in South African education, technology, sport, the community, employment equity and the environment. BMW South Africa has implemented an HIV/AIDS programme designed by the workforce and is also committed to sustainability by using environmentally compatible materials, designing components suitable for end-of-life recycling and researching and developing alternative mobility concepts (Van der Merwe & Visser 2008:196).

6.6.3.2 Mercedes-Benz

Mercedes-Benz's manufacturing plant is in East London. The company's headquarters are located in Zwartkops, Gauteng, from where the Mercedez-Benz, Smart, Maybach, Mitsubishi Motors, Freightliner, Western Star and FUSO brands are marketed and financed. The company is committed to South African democracy and to being a good corporate citizen. Mercedes-Benz SA recently spent about R2 billion on upgrading its manufacturing plant, and now produces both right- and left-hand drive versions of the latest Mercedes-Benz C-Class car for domestic and export markets. Some key corporate social responsibility focus areas are education, health (especially HIV/AIDS and tuberculosis), community development and safety, environment and sport development (DaimlerChrysler 2008).

6.6.3.3 Volkswagen

Established in 1946, Volkswagen Group South Africa is a wholly owned subsidiary of Volkswagen Aktiengessellschaft (VWAG) in Germany. It is the largest German investment in South Africa and is a major contributor to foreign direct investment, technology transfer and skills development. Volkswagen Group South Africa is located in Uitenhage, an industrial town some 35 km from Port Elizabeth in the Eastern Cape. For generations, Volkswagen Group South Africa has led the pack in the key areas of transformation. Volkswagen Group South Africa believes strongly that job creation and skills development will fuel transformation. The company's first priority is therefore to build a strong and successful business which protects and creates jobs within Volkswagen Group South Africa and the broader Volkswagen family of suppliers and franchised dealers. As a multinational corporation, Volkswagen Group South Africa also has a strong commitment to boosting foreign direct investment in South Africa and to promoting the transfer of world-class technology, knowledge and skills (Volkswagen South Africa 2012).

6.6.3.4 General Motors

General Motors South Africa is a wholly owned subsidiary of General Motors Corporation. Its manufacturing plant is located in Port Elizabeth in the Eastern Cape. The sales and marketing office is based in Johannesburg. General Motors' products include Chevrolet, Opel, Isuzu, Hummer, Saab and Cadillac. General Motors South Africa also exports its products to sub-Saharan African countries. The company employs approximately 3 700 employees and provides jobs for many people in the Port Elizabeth area. Community involvement focuses specifically on education (General Motors 2008).

6.6.3.5 Toyota

Toyota is one of South Africa's largest automotive producers and exporters. Its manufacturing plant in Prospection is one of the most advanced facilities of its kind in the country. Its Prospection facility, just south of Durban, is now one of the most technologically advanced Toyota facilities in the world outside of Japan, and is capable of producing around 220 000 units a year. As a global production facility, Toyota South Africa has transformed from a purely local supplier into an effective export base to supply vehicles into markets in Europe and Africa. The company, which exports to more than 40 destinations, says it expects to export around 140 000 units in 2008, or almost 60% of total automotive exports from South Africa. Toyota's commitment to corporate social responsibility is incorporated into its vision, namely "prosperity for all stakeholders through world competitiveness and continuous growth". Toyota contributes to the environment through its hybrid vehicle technology. The company contributes to employee and community wellness through its HIV/AIDS programme and the Toyota Academy, its training division. Being part of a Japanese group of companies, the concept of kaizen, or continuous improvement, is a key focus area (Toyota 2009).

6.6.3.6 Nissan Motors

For the last 40 years, Nissan South Africa has supplied quality vehicles to South African customers, vehicles which have met the specific needs of the South African market. Initially, through the importation and local assembly of completely knocked down (CKD) vehicles, followed by the establishment of manufacturing facilities at Rosslyn, near Pretoria, Nissan and its forerunner, Datsun, have provided transport solutions for South Africans while developing the country's motor industry. Today, with the transformation of the country and along with it the unrestricted and highly competitive motor vehicle market, Nissan is set to continue its significant role in the South Africa automotive market. To meet its objective of significantly growing its market share, Nissan South Africa is currently engaged in a dynamic programme of new model introductions. A total of over 1 800 people are employed by Nissan in South Africa and, as part of its social responsibility efforts, the company is committed to training, educating and advancing its workforce to the maximum potential of each individual. Other elements of Nissan's investment in upgrading the social fabric of our society focus on adult and child education, child welfare and job creation (Nissan Motors 2010). Table 6.7 classifies the light vehicle manufacturers surveyed in the study according to their parent companies.

Table 6.7: Classification of light vehicle manufacturers according to parent companies

Light vehicle manufacturers	Location of parent company
Toyota, Nissan	Asia
General Motors	America
Mercedes-Benz, BMW and Volkswagen	Europe

Source: Researcher's own construction

6.7 DATA COLLECTION AND METHODS

Different sources of evidence are used to present answers/solutions in the form of arguments or problems. These sources and methods of collection of data are presented in this subsection.

6.7.1 Sources of research data

Both primary and secondary sources of data were used in this study, as explained below.

6.7.1.1 Primary (original) sources

Primary sources are original materials on which other research is based. They are originated by a researcher to address a particular problem at hand (Malhotra 2004:37). Primary research may be exploratory, descriptive or causal (McGivern 2006:61). They are firsthand testimony or direct evidence concerning a topic under consideration. They present information in its original form, neither interpreted nor condensed, nor evaluated by other writers. Primary sources are records of events as they are first described, without any interpretation or commentary. They are also sets of data, such as census statistics, which have been tabulated, but not interpreted. Reprints or digital reproductions of primary source materials often provide access to rare or out-of-print resources. Examples of primary sources include works of literature and art, diaries, letters, interviews, speeches, research data and records of organisations.

6.7.1.2 Secondary (critical) sources

Secondary data are data collected for some purpose other than the problem at hand (Malhotra 2004:37). Secondary sources offer interpretation or analysis based on primary sources. Secondary sources utilise primary sources. They may analyse, restate, describe or explain the information provided within primary source material. In many cases, secondary sources utilise primary sources to argue or back up a point of view. Examples of secondary sources used in the study are textbooks, journal articles, news articles, websites, reports that interpret or review research works on automotive industry SCM practices and strategies (McGivern 2006:62).Table 6.8 summarise the major differences between primary and secondary sources of data.

Table 6.8: Differences between primary and secondary sources of data

Activity	**Primary**	**Secondary**
Purpose	For the problem at hand	For other problems
Process	Very involved	Rapid and easy
Cost	High	Relatively low
Time	Long	Short

Source: Adapted from McGivern (2006:62)

6.7.2 Methods of collecting data

The methods of collecting data can rely on different sources of evidence. These include (1) documentation, (2) archival records, (3) interview, (4) direct observation, (5) participant observation, and 6) physical artefacts. Denzin and Lincoln (1994) also mention seven methods: (1) interview, (2) direct observation, (3) analysis of artefacts, (4) documents, (5) cultural records, (6) visual materials, and (7) personal experiences. There are four sources: (1) participation in the setting, (2) direct observation, (3) in-depth interviewing, and (4) analysing documents and material culture. Hence no single source has a complete advantage over all others.

The set of data that was used for this study includes the following: (1) documentary data (literature sources), and (2) interview data. Documentary (literature) data were collected to establish an understanding of the concept of supply chain management, supply chain strategies and the global and South African automobile industry. These data were covered in chapters 2 to 5 and form the basis of the questions in the interviews. The second set of data was derived from in-depth face-to-face interviews using a semistructured questionnaire.

6.7.2.1 Documentary data (literature)

Documentary data may take the form of textbooks, journal articles, reports, newspapers, formal studies, agenda, announcements and minutes of meetings, etc, and other forms of communication. In this study, these documentary data were used to obtain information on current SCM practices, strategies, the global and South African automobile issues and they form part of the literature review. This data were also used to compile the interview questions.

6.7.2.2 Interviews

An interview is a form of primary research (McGivern 2006:64). There are different forms of interviews, and they vary according to content, such as seeking factual information, attitudes, opinions, narratives and/or life histories. The “purposes” of an interview are as follows: firstly, they are empirical in the sense that information is gathered on a particular topic; and secondly, they are theoretical, in that a theory is tested or developed (ie grounded theory). Interviews can be conducted in a variety of formats including individual or group face-to-face verbal interchange, mailed or self-administered questionnaires, telephone surveys and electronic interviewing via fax, email and internet (McGivern 2006:61).

Interviews can differ in their degree of structure, from a well-structured sequence of questions, through focused interviews following a particular set of questions to an open-structure with no predetermined sequence or formulation of questions, where respondents are asked for facts as well as their opinions. In a structured interview, each interviewee receives the same series of questions in the same order. Interviews are a useful way of obtaining large amounts of data quickly and provide the means for immediate follow-up questions, if required, for clarification or to obtain additional information.

Two broad types of questions can be asked in an interview, namely open and closed ended. In open-ended questions, the interviewee has total freedom and flexibility to respond, whereas in closed-ended questions they are limited to the alternatives provided. Open-ended questions allow interviewees to respond in “their own words”, with this type of question structure not “prompting” responses. Closed-ended questions are more structured in that interviewees are required to “tick” a category/box (variability in answers is reduced). They are also easier to answer and the responses are easier to computerise and analyse. Even though open- and closed-ended questions have different characteristics, the quality of the collected data depends, for example, on the interviewee’s level of knowledge, the way he or she interprets the questions, the responses he or she gives to the question, the way in which the interviewer interprets the responses and the type of coding performed.

In employing a semi-structured interview questions strategy, there is an assumption that the questions will worded and ordered in a way that all the interviewees will understand. Although the interviewees may have different perspectives and use different words, the terms and/or concepts may not be the same. In this study, face-to-face interviews were conducted with senior supply chain actors. A semi-structured interview questionnaire was used to elicit the opinions of the respondents on supply chain practices and strategies. The researcher made sure each respondent understood the terminology (eg through use of a background brief) and clarifications were made where necessary. A pre-test (pilot test) of the interviews was conducted at Nissan and Toyota with three respondents in order to determine whether the respondents understood the questions asked. Corrections were made and the questionnaire streamlined.

For each manufacturer, a model was chosen on which the interviews were based. This is because strategies are determined by product characteristics, manufacturing characteristics and the decision drivers, as discussed in chapter 5. A total of 12 (N = 12) in-depth interviews utilising the purposive sampling technique were conducted. In some instances, more than one interview was conducted in a manufacturer to gain a better understanding. Also, in other situations, more than one respondent completed different sections of the interview questionnaire. This was because of the differences in the organisational structures of the companies. The interview questionnaire comprised two sections, namely section A, supply chain management practices, and section B, supply chain strategies. The constructs in the questions were measured using a five-point Likert-type response format with end points (1) “strongly disagree” to (5) “strongly agree” and (1) “no extent” to (5) “a very great extent”. Table 6.9 below indicates the different sections in the interview questions and the research questions they were supposed to address.

Table 6.9: Research questions in different sections of the interview questionnaire

Interview questionnaire	Research questions
Section A: Supply chain management best practices	• What is the extent to which supply chain best practices are implemented by local manufacturers of light vehicles in South Africa? • What are the supply chain challenges faced by local manufacturers of light vehicles in South Africa? • What is (are) the most important key supply chain performance indicator(s) that contributes to optimising the supply chain performance of local manufacturers of light vehicles in South Africa?
Section B: Supply chain strategies	• What is the supply chain strategy of local manufacturers of light vehicles based on product line characteristics? • What is the supply chain strategy of local manufacturers of light vehicles based on manufacturing characteristics? • What is the supply chain strategy of local manufacturers of light vehicles based on the decision drivers of SCM? • What is the difference between the supply chain practices and strategies of manufacturers of different parent company origins in South Africa?

6.8 DATA ANALYSIS

"Data analysis is the process of bringing order, structure and interpretation to the mass of collected data" (Yin 2003:150). According to Zikmund et al (2010:70), data analysis usually involves reducing accumulated data to a manageable size, developing summaries, looking for patterns and applying statistical techniques (Cooper & Schindler 2003:87). Hence the purpose of data analysis is to interpret and draw conclusions from the mass of collected data (Tustin et al 2005:102). In its simplest form, data analysis may involve determining consistent patterns and summarising the relevant details revealed in investigation. The appropriate analytical technique for data analysis determines the information requirements, the characteristics of the research design and the nature of the data gathered (Zikmund et al

2010:70). The data for this study were analysed descriptively using Statistical Package for Social Sciences (SPSS). Descriptive statistics were used to describe the main features of the data in quantitative terms, and inferential statistics used to determine statistically significant differences. The open-ended responses were used to give more meaning to the respondents' views on questions where applicable (Gray et al 2007:44).

6.9 QUALITY OF THE RESEARCH

When conducting empirical studies, it is vital that the method and data collection are properly prepared, in order to avoid systematic and random errors and to increase the quality of the research. Validity and reliability should be considered to ensure the quality and trustworthiness of research, as explained below (De Vaus 2001).

6.9.1 Validity

Validity is a key concept in assessing the quality of research (McGivern 2006:79). It is vital for one's credibility to thoroughly investigate all collected material and that the data from interviews are valid and correct. Validity is explained as the correctness of a description, conclusion, explanation or interpretation - in other words, how well the collected data have been investigated and interpreted. According to Yin (2003), when conducting research, the researcher should try to use multiple sources of evidence in order to improve the reliability and validity of the study. This is called triangulation. To ensure the integrity, validity and accuracy of the findings, different steps were taken. Firstly, the principles of triangulation such as the following were used to collect and investigate the data:

- different sources (interview and literature study)
- different measures (important viewpoints were noted during interviews)
- different types of questions (some of the questions required comment/justification of response)
- different methods (exploratory and descriptive design with qualitative and quantitative approaches)

Secondly, interpretational threats were diminished by affording the respondents the opportunity to speak freely about the categories asked about. Threats to the validity of a study, however, can either be descriptive and/or interpretational. The former relates to how one understands what is being heard or seen. To minimise the threat to inaccurately describe information received from face-to-face interviews, an interview diary was kept of what was being said and discussed. In addition, questions had to be reformulated during the interview if the question was not understood and thus difficult to interpret.

6.9.2 Reliability

In addition to the importance of data validity, De Vaus (2001) states that the data collected need to be reliable and trustworthy. High reliability means that the result is errorless and that the measure used will give the same result consistently. According to Jung and Widmark (2004), research with good reliability ensures that another investigator would obtain the same results when using the same methods at another point in time and with another sample. In order to maintain reliability, the researcher used the same procedure to obtain the results. Reliability was increased by ensuring that leading and subjective questions are avoided. Also, all notes and the completed questionnaires will be kept in a database for a period of at least three years at the University of South Africa (Unisa) for the purpose of verification and then destroyed. To achieve consistency, biases and errors were minimised. Errors were minimised by entering the responses in an Excel spread sheet as soon as the interview had been conducted.

6.10 ETHICAL CONSIDERATIONS

The researcher's ethical responsibilities did not rest only with respondents. Ethical responsibilities to the client or funders of the research are vital (McGivern 2006:30). There are three types of ethical guidelines for interviews that a researcher should consider. These are informed consent, confidentiality (the right to privacy and protecting identification) and consequences (protection from, say, physical and emotional harm). These guidelines focus on how ethical factors will be addressed in the study.

6.10.1 Informed consent

Informed consent relates to the principle of voluntary participation in research (McGivern 2006:28; Gray et al 2007:90). Before the interview, the researcher provided the respondents with details of the research topic, the overall purpose and the outline of the key themes to be discussed during the interview (brief background). The respondents were informed timeously to enable them to prepare for the interview session. Also, the interviewees were informed of the objectives of the study, the methods to be used and how the response data would be used, they were assured of their anonymity and that confidentiality would be maintained.

6.10.2 Confidentiality

Ensuring the anonymity and confidentiality of participants and the data they provide are two ways in which the well-being and interests of respondents can be protected (McGivern 2006:28; Gray et al 2007:87). To maintain confidentiality, all the interviewees were informed that their names would remain anonymous. No reference was made to any individual in the presentation of the results, the analysis of data and the discussion of the outcomes. The respondents were informed that the interview data would be kept confidential and destroyed after three years.

6.10.3 Consequences

Consideration was giving to participation, the design of the interviews, potential harm and the expected benefit of participation in the study. The interviews were designed to obtain specific information about supply chain practices and strategies in the South African automobile industry. This ensured that the interviewees were comfortable answering personal questions.

6.11 THE RESEARCH PROCESS FOLLOWED IN THE STUDY

The research process used in this study is summarised in table 6.10 and indicates the purpose of the study, design, population, data, analysis and ethical considerations.

Table 6.10: Summary of the research process used in this study

Activity	Description of process
Aim or purpose of the study	To determine SCM best practices and strategies implemented by local vehicle manufacturers in South Africa
Research design	Exploratory and descriptive
Research approach	Inductive (conclusions drawn from empirical findings); qualitative and quantitative approaches (in-depth understanding of the problem)
Research strategy	Survey of light vehicle manufacturers (provides the opportunity to obtain general or overall insight into and investigate the similarities and differences between manufacturers)
Population	Light vehicle manufacturers in the South African automobile industry (Toyota, Volkswagen, General Motors, Nissan, BMW and Mercedes)
Sampling	Purposive sampling
Sources of data	Primary and secondary sources
Data collection method	Face-to-face interviews (semi-structured questionnaire)
Data analysis	Descriptive statistics (SPSS); inferential statistics
Quality of the research	Achieved through validity and reliability
Ethical considerations	Achieved through informed consent, confidentiality and consequences

Source: Researcher's own construction

6.12 CHAPTER SUMMARY

In this chapter the research design and methodology were discussed. The research design that was employed was a combination of exploratory and descriptive research design using quantitative and qualitative approaches. The study used face-to-face interviews with semi-structured questions. Furthermore, the purposive sampling technique was used. Data analysis and interpretation were done by descriptive statistics using SPSS and inferential statistics by means of a nonparametric test. This chapter also discussed the validity and reliability of the study. Chapter 7 deals with the results of the study by presenting the practices and strategies employed by light vehicle manufacturers in South Africa.

CHAPTER 7

FINDINGS ON PRACTICES AND STRATEGIES EMPLOYED BY LIGHT VEHICLE MANUFACTURERS IN SOUTH AFRICA

7.1 INTRODUCTION

Chapter 6 reviewed the research methodology that was used to obtain information to address the research questions posed in this study. The primary focus of this chapter is to present, analyse and interpret the research data with a view to determining the extent to which optimal supply chain practices and strategies are implemented by local manufacturers of light vehicles in South Africa. Presentation, analysis and interpretation of the results are discussed under different sections and questions in the interview questionnaire. The questionnaire was semi-structured and consisted of two major sections. The findings of the study are presented and analysed using tables, figures and graphs. In some instances, preliminary deductions are made. As stated in chapter 6, the focus of this study was local manufacturers of light vehicles in South Africa.

Twelve (N=12) face-to-face interviews were conducted at six of the seven local manufacturers of light vehicles in South Africa. Only locally manufactured cars were the focus of this study. One of the light vehicle manufacturers refused to participate in the study. The interviews were conducted at different manufacturers for a particular locally manufactured car (model). As indicated by Fisher (1997), a supply chain strategy is not dependent on a supply chain, but on a product (or in this study a model). Different strategies can be employed in an organisation for different products. Therefore, in this study, the interviewees who constituted senior supply chain managers had to identify a locally manufactured model (production line) on which the interview would be based. Six models were identified for the study, one from each manufacturer. Table 7.1 presents the production lines that were chosen.

Table 7.1: Light vehicle manufacturers and the models chosen for the study

Manufacturer	Production line	No. of interviews
European manufacturer 1	Model X	2
American manufacturer	Model J	2
European manufacturer 2	Model Y	1
Asian manufacturer 1	Model Z	4
Asian manufacturer 2	Model W	1
European manufacturer 3	Model U	2

For some manufacturers, senior managers had to complete different sections of the interview questionnaire. The first section of the chapter discusses supply chain practices, and the second section supply chain strategies. After providing the background to this chapter, the remaining sections of the chapter deals with the findings and interpretations.

7.2 SUPPLY CHAIN MANAGEMENT BEST PRACTICES

The first section of the interview questionnaire relates to SCM best practices. The section is subdivided into inbound supply chain best practices (relationships with main suppliers), internal supply chain best practices (the local manufacturer) and outbound supply chain best practices (relationship with main customers). The section also examines potential challenges in the South African automotive industry as well as key supply chain performance indicators in the various manufacturers.

7.2.1 Inbound supply chain best practices

In this subsection, the respondents were asked to indicate on a five-point Likert response format with end points 1 (no extent) to 5 (very great extent), the extent to which they implement supply chain best practices with their main suppliers. The subsection comprised nine statements. Table 7.2 indicates the extent of implemented supply chain best practices for local automotive manufacturers in South Africa with their strategic suppliers. The practices are arranged according to the highest value of their mean scores.

Table 7.2: The extent of supply chain best practices with strategic suppliers

Practices	Mean	Median
We have long-term relationships with our strategic suppliers	4.58	5.00
We cooperate with our strategic suppliers to improve operations	4.50	5.00
We communicate with our strategic suppliers on new product development	4.25	4.00
We cooperate with our strategic suppliers to improve processes	4.42	5.00
We form strategic partnerships with our suppliers	4.42	5.00
We share relevant information with our strategic suppliers	4.42	4.00
We have trusting relationship with our strategic suppliers	3.92	4.00
We share our objectives and goals with our strategic suppliers	3.92	4.00
We share supply chain risks with our strategic suppliers	3.67	4.00

The results indicate that long-term relationships with strategic suppliers (mean of 4.58 and median of 5) are considered to be the practices that have been implemented the most (rated as to a great or very great extent by all the manufacturers). However, the practice of sharing supply chain risks with their strategic suppliers had the lowest mean (3.67), indicating that some manufacturers implemented this practice only to a slight extent. Overall, most of the best practices were implemented to a great or very great extent, as indicated by the range of the mean, 3.92 to 4.58 and median values of 4.00 or 5.00. This shows that overall supply chain best practices were used by all the manufacturers for their inbound supply chain.

7.2.2 Outbound supply chain best practices

With reference to the outbound supply chain practices, the respondents were asked to indicate on a five-point Likert response type format from 1 (no extent) to 5 (very great extent), the extent to which they implemented supply chain best practices with their strategic customers (dealers). The subsection comprised nine statements. Table 7.3 shows the extent of implemented supply chain best practices of local automotive manufacturers in South Africa with their dealers. The practices are arranged according to the highest value of their mean scores.

Table 7.3: The extent of supply chain best practices with strategic customers (dealers)

Practices	Mean	Median
We have a long-term relationships with our strategic customers	4.33	4.00
We share relevant information with our strategic customers	4.25	4.00
We form strategic partnerships with our customers	4.08	4.00
We communicate with our strategic customers on new product development	4.08	4.00
We have trusting relationships with our strategic customers	3.92	4.00
We share our objectives and goals with our strategic customers	3.92	4.00
We cooperate with our strategic customers to improve processes	3.83	4.00
We cooperate with our strategic customers to improve operations	3.67	3.50
We share supply chain risks with our strategic customers	3.17	3.00

Table 7.3 shows that long-term relationships with strategic customers with a mean value of 4.33 and median 4.00 was the most implemented best practice. This was followed by sharing relevant information (mean of 4.25 and median 4.00), and then forming strategic partnerships and communicating with new product development (mean 4.08 and median 4.00) (rated by the majority of the manufacturers as "to a great or very great extent"). The least implemented best practice with strategic customers was sharing supply chain risk (mean 3.17 and median 3.00) with responses distributed from "no extent" to "a very great extent". However, most of the best practices are implemented to a moderate or great extent as indicated by the range of the mean (3.67 to 4.33) and a median value of 3.50 or 4. This indicates that outbound supply chain best practices are fairly implemented with strategic customers, but that there is definite scope for improvement with other best practices.

7.2.3 Internal supply chain best practices

In this subsection of the questionnaire, the respondents were asked to indicate on a five-point Likert response format from 1 (no extent) to 5 (very great extent), the extent to which they implement supply chain best practices with other departments in their organisation. The subsection comprised six statements. Table 7.4 indicates the extent to which the supply chain unit implements supply chain practices with other departments. The practices are arranged according to the highest value of their mean scores.

Table 7.4: The extent of the implemented supply chain best practices with internal supply chain

Practices	Mean	Median
We share relevant information with other departments	4.67	5.00
We cooperate with other departments to improve operations	4.33	4.50
We cooperate with other departments to improve processes	4.33	4.00
We ensure alignment between our objectives and goals with those of other departments	4.25	4.50
We communicate with other departments on new product development	4.17	4.50
We share supply chain risks with other departments	3.75	4.00

Sharing relevant information with other departments was the most implemented best practice (mean 4.67 and median 5.00). This is followed by cooperation with other departments to improve operations and processes (mean 4.33 and median 4 and 4.50). Once again the issue of other departments sharing supply chain risk was the least implemented best practice (mean 3.75 and median 4.00). Aligning objectives and goals with those of other departments and communicating with other departments on new product development were also implemented from a great to a very great extent, with means of 4.17 and 4.25 and medians of 4.50, respectively. This result shows that in the internal supply chain of local manufacturers, supply chain best practices are implemented to a great extent to improve supply chain efficiency. Sharing supply chain risks had the lowest mean value and reflects the same position for the inbound and outbound supply chain, an issue that merits possible further investigation.

Based on the analysis of practices across the supply chain, it was evident that optimal supply chain best practices are implemented to at least a great extent. Highly rated practices such as long-term relationships, cooperation to improve process as well as collaboration on new product development (means of 4.25 to 4.58) are a strategic tool that aims to achieve common working goals to reduce costs and improve quality, thus increase shareholder value.

In both the inbound and outbound supply chain practice, “building long-term relationships” was the most implemented best practice while “sharing supply chain risks” was the least implemented. Another observation is that while “cooperation to improve processes and operations” was among the top five most implemented best practices of inbound supply chain (a mean of 4.42 to 4.5), it was actually the least implemented practice of the outbound supply chain (a mean of 3.67 to 3.83). This implies that there is evidence of a silo mentality in the distribution side of the supply chain - hence an area for further investigation.

7.2.4 Supply chain best practices by different automotive manufacturers

This subsection presents the analysis of supply chain best practices implemented by individual manufacturers. Inbound supply chain practices by manufacturers are discussed first, followed by outbound supply chain best practices by manufacturers and then internal supply chain best practices. Table 7.5 indicates inbound supply chain best practices with regard to the particular vehicle (model) included in this study. For analysis purposes of , the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 7.5: Inbound supply chain best practices by different manufacturers

Statements	Mean					
	E1	**AM**	**E2**	**A1**	**A2**	**E3**
We form strategic partnerships with our strategic suppliers	5.00	4.00	5.00	4.00	5.00	4.50
We have long-term relationships with our strategic suppliers	5.00	4.00	5.00	4.25	5.00	5.00
We cooperate with our strategic suppliers to improve operations	5.00	4.00	5.00	4.25	4.00	5.00
We cooperate with our strategic suppliers to improve processes	5.00	4.00	5.00	4.00	4.00	5.00
We have trusting relationships with our strategic suppliers	4.50	4.00	4.00	3.25	4.00	4.50
We communicate with our strategic suppliers on new product development	5.00	4.00	5.00	4.00	5.00	3.50
We share relevant information with our strategic suppliers	5.00	4.00	4.00	4.25	5.00	4.50
We share our objectives and goals with our strategic suppliers	4.00	3.50	4.00	3.75	4.00	4.50
We share supply chain risks with our strategic suppliers	4.50	3.00	4.00	3.25	3.00	4.50

Table 7.5 indicates that overall, European manufacturers 1 and 2 implemented supply chain best practices, from a great to a very great extent, with mean ratings of 4.00 and 5.00. American manufacturer, Asian manufacturer 1 and 2 and European manufacturer 3 implemented inbound supply chain best practices, from a moderate extent to a very great extent with mean ratings from 3.00 to 5.00. The least implemented best practices by

manufacturer were the American manufacturer and Asian manufacturer 2 for sharing supply chain risks with strategic suppliers (a mean of 3.00).

Table 7.6 indicates the mean ratings on how the manufacturers implemented outbound supply chain best practices. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 7.6: Outbound supply chain best practices by manufacturers

Statements	Mean					
	E1	**AM**	**E2**	**A1**	**A2**	**E3**
We form strategic partnership with our customers	4.00	4.50	5.00	3.25	5.00	4.50
We have long-term relationships with our strategic customers	4.00	4.50	5.00	4.00	5.00	4.50
We cooperate with our strategic customers to improve operations	3.50	3.50	4.00	3.25	3.00	5.00
We cooperate with our strategic customers to improve processes	3.50	4.00	4.00	3.50	3.00	5.00
We have trusting relationships with our strategic customers	4.00	4.00	5.00	3.25	4.00	4.50
We communicate with our strategic customers on new product development	4.50	4.50	4.00	4.50	2.00	3.50
We share relevant information with our strategic customers	4.00	5.00	5.00	3.75	4.00	4.50
We share our objectives and goals with our strategic customers	4.50	4.00	4.00	3.50	3.00	4.50
We share supply chain risks with our strategic customers	3.50	2.00	4.00	2.75	3.00	4.50

From the results, it can be deduced that overall, only European manufacturer 2 implemented outbound supply chain best practices, from a great to a very great extent (a mean of 4.00 to 5.00) with its strategic customers. The distribution of the findings for the other manufacturers supply chain best practices on the customer side of the supply chain overall, varied from a mean of 2.00 to 5.00. Maximum mean ratings of 5.00 were recorded for sharing relevant information (American manufacturer and European manufacturer 2), having trusting relationships (European manufacturer 2), establishing long-term relationships (European manufacturer 2 and Asian manufacturer 2) and cooperation to improve processes and operations (European manufacturer 3) with its strategic customers. The lowest mean rating (2.00) was recorded for the American manufacturer for sharing supply chain risks and Asian manufacturer 2 for communicating with strategic customers on new product development.

Table 7.7 provides the mean ratings on how the manufacturers implemented internal supply chain best practices. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 7.7: Internal supply chain best practices by manufacturers

Statements	**Mean**					
	E1	**AM**	**E2**	**A1**	**A2**	**E3**
We cooperate with other departments to improve operations	5.00	4.50	5.00	4.50	3.00	3.50
We cooperate with other departments to improve processes	5.00	4.00	5.00	4.50	3.00	4.00
We communicate with other departments on new product development	5.00	4.50	4.00	4.00	5.00	3.00
We share relevant information with other departments	5.00	4.50	5.00	4.50	4.00	5.00
We ensure alignment between our objectives and goals with those of other departments	4.50	4.50	5.00	4.00	4.00	4.00
We share supply chain risks with other departments	4.50	4.00	5.00	3.75	3.00	2.50

European manufacturer 1 and 2 and the American manufacturer implemented internal supply chain best practices, on average, from a great to a very great extent (a mean of 4.00 to 5.00). Asian manufacturers 1 and 2 implemented internal supply chain best practices, overall, from a moderate to a very great extent (means of 3.00 to 5.00), while European manufacturer 3 implemented internal supply chain best practices, from a slight extent (a mean of 2.50) to a very great extent (a mean of 5.00). The least implemented practice was recorded for European manufacturer 3, with a mean of 2.5 for sharing supply chain risks with other departments. Generally speaking, the manufacturers implemented the best supply chain practices in their internal supply chain. Communication, cooperation and sharing risks received more attention at some of the manufacturers.

7.2.5 Challenges in the supply chain

Question 4 of the questionnaire contained statements that seek to determine supply chain challenges impacting on the performance of the South African automotive manufacturers as well as the complexity of overcoming challenges. In the first part (determining challenges), the respondents were asked to indicate their level of agreement on a five-point Likert response format scale from 1 (strongly disagree) to 5 (strongly agree). Twenty-three (23) statements representing potential challenges were made. The respondents were also asked to identify other challenges that were not stated. For the purpose of analysis, the challenges were grouped into technological, infrastructural, cost, market/service, relationship and skills challenges. The frequency distribution (in %) per statement is indicated in table 7.8. For the purpose of analysis the following abbreviations were used: SD for strongly disagree; D for disagree; N for neither agree nor disagree, A for agree; and SA for strongly disagree.

Table 7.8: Supply chain challenges facing South African automotive manufacturers

Challenges	Percentage (%)				
	SD	D	N	A	SA
Technological challenges					
We have inadequate information systems	50.0%	25.0%	0.0%	16.7%	8.3%
We have an inefficient planning and forecasting tool	50.0%	25.0%	0.0%	25.0%	0.0%
We incur high cost when replacing obsolete assembly/manufacturing tools	0.0%	0.0%	8.3%	83.3%	0.0%
Infrastructural challenges					
We do not have sustainable infrastructure	33.3%	8.3%	33.3%	25.0%	0.0%
Rail transport is unreliable	0.0%	25.0%	25.0%	33.3%	16.7%
We normally have rail capacity problems	16.7%	33.3%	50.0%	0.0%	0.0%
Increased road freight volumes	8.3%	8.3%	16.7%	33.3%	33.3%
We are challenged by delays at ports	8.3%	0.0%	0.0%	33.3%	58.3%
Cost challenges					
High fuel costs affect our operating costs	0.0%	0.0%	0.0%	41.7%	58.4%
We have high operating costs	0.0%	0.0%	8.3%	58.3%	16.7%
We incur high costs at South African ports	0.0%	0.0%	0.0%	33.3%	58.3%
The prices of materials/components are high	8.3%	16.7%	0.0%	58.3%	8.3%
Market/service challenges					
It is difficult finding new markets	8.3%	8.3%	25.0%	41.7%	16.7%
Sometimes, our customers cancel their orders	0.0%	8.3%	16.7%	41.7%	33.3%
We are challenged to improve our service level	8.3%	25.0%	0.0%	25.0%	41.7%
Relationship challenges					
It is difficult to verify the BBBEE status (scorecards) of our strategic suppliers	41.7%	25.0%	16.7%	8.3%	0.0%
It is sometimes difficult to collaborate with our strategic suppliers	25.0%	33.3%	8.3%	25.0%	0.0%
It is sometimes difficult to collaborate with our strategic customers	33.3%	25.0%	16.7%	16.7%	0.0%
We operate with a low level of collaboration	50.0%	41.7%	0.0%	0.0%	0.0%
Production/skills challenges					

We have unreliable production schedules	33.3%	58.3%	0.0%	8.3%	0.0%
We are challenged by a lack of capacity	16.7%	8.3%	33.3%	25.0%	16.7%
We are challenged by a lack of skills	8.3%	16.7%	16.7%	41.7%	16.7%
We are challenged by labour problems	8.3%	8.3%	16.7%	16.7%	50.0%

(Note: Some of the percentages do not add up to 100% on account of missing values, because some respondents did not answer specific statements relating to the challenges).

7.2.5.1 Technological challenges

The majority of the respondents did not agree with the statement about “inadequate information systems” and “efficient planning and forecasting tools” (75.0%). Only 25.0% of the respondents felt that these issues were a potential challenge. A total of 83.3% of the respondents indicated that they agree that “incurring high cost when replacing outdated assembly/manufacturing tools” is a challenge. The results show that information technology is highly utilised by the majority of the local manufacturers in the South African automotive industry. This confirms the SCIR (2009) research report, which asserted that there is high usage of information technology in the South African automotive industry. This study indicates that “it is costly to replace existing assembly/manufacturing tools” is a huge challenge for manufacturers (83.3% on average).

7.2.5.2 Infrastructural challenges

The results pertaining to infrastructure indicate a spread of responses with a third (33.3%) of the respondents indicating that they were not sure if “sustainable infrastructure” was a challenge, 41.6% disagreed or strongly disagreed, while 25% agreed that it was a challenge. “Reliability of the rail” as a means of transportation was a potential challenge according to half (50%) of the respondents. However, a quarter (25%) of the respondents noted that they were unsure if it was a challenge, and 25% disagreed.

In terms of “rail capacity problems’’ encountered, 50% of the respondents asserted that this was not a challenge, while the other half of respondents (50%) were unsure. Hence none of the respondents indicated that there was a rail capacity problem. The majority of the respondents (66.6%) agreed that “increased road freight volume” was a challenge. Almost all the respondents agreed that the industry was challenged by “delays at port” (91.7%). The results reveal that “sustainable infrastructure” and “rail capacity” were not serious challenges that could affect the performance of local manufacturers in South Africa. However, reliability of rail, delays at port and increased road freight volumes were challenges that impact on the performance of automotive manufacturers. In relation to this challenge, according to Van der Merwe (2009), the number of containers that can be cleared at the port per hour is too low and Cape Town is the most uncompetitive port among 17 ports included in a study by the Automotive Development Centre (AIDC). The results also confirm the findings of the AutoWorld Report (2010), that there are problems with congested ports and terminals, particularly in Durban.

Nonetheless, there were some instances where the respondents were unsure whether or not it was a challenge, such as “unsustainable infrastructure” (33.3%), “unreliability of rail transport” (25.0%) and “rail capacity problems” (50.0%). A possible reason for this could be that the respondents did not have an opinion and some were not using rail transport and were therefore indifferent (only towards road transportation).

7.2.5.3 Cost challenges

In terms of cost challenges, “high fuel cost” (100% agreement) and “incurring high cost at South African ports” recorded the highest ratings in agreement. Three-quarters (75%) of the respondents indicated that “incurring high operating cost” was a challenge. According to two-thirds of the respondents (66.6%), the “high prices of material and components” were a challenge. This result also shows that cost is a major challenge in the South African automotive industry. This result confirms the findings of Naude and Badenhorst-Weiss (2011). Cost challenges which include high fuel cost, operating cost, cost due to delays at ports and high prices of components and materials affect the performance of the industry and its competitive position worldwide. It is noted that the South African port charges are much higher than its BRIC counterparts. This challenge obviously leads to high prices of new vehicle sales in South Africa and makes South Africa automotive manufacturers globally uncompetitive and therefore influences the export of locally manufactured automobiles. It takes an average South African 164 weeks of earnings to buy and finance an average priced new vehicle compared to only 26 weeks in America (Walker 2006).

7.2.5.4 Market/service challenges

Market and service challenges entail issues relating to finding new markets, cancellation of customer orders as well as improving service levels. The results indicate that just over half (58.4%) of the respondents agreed that “finding new markets” was a challenge. The majority

(75%) of the respondents indicated that "customers cancelling their orders" was a challenge. "Improving service level" was also a challenge according to two-thirds (66.7%) of the respondents. This could indicate that parent companies were "exploring new markets".

Based on the results, it is evident that the South African automotive industry is challenged in its market and services - hence the need to improve service levels and explore new and emerging markets for exports. The result confirms the report by AutoWorld (2010), which states that the industry is unfortunately still not renowned for world-class service. If consumer fulfilments are attained as first priority, then the industry will have to work even harder to provide the demanding millennium customers with the level of service they expect. This challenge may also inhibit the industry from finding new markets because of competition from developing economies such as China, India and South America. Hence South Africa may be in a better position to explore the African market.

7.2.5.5 Relationship challenges

In terms of relationships with partners in the supply chain, the respondents were asked to indicate if verifying the BBBEE status (scorecard) of their strategic suppliers was a challenge. Two-thirds of the respondents asserted that it was not a challenge (66.7%), while only 8.3% felt that verifying BEE status was a challenge. Collaborating with strategic suppliers was not considered a challenge by more than half of the respondents (58.3%), while only a quarter (25%) felt it was a challenge. With reference to strategic customers, more than half of the respondents confirmed that it was not a challenge to collaborate (58.3%), and only 16.7% noted that it was. Lastly, all the respondents (100%) disagreed that "operating at a low level of collaboration" was a challenge. This is in line with common knowledge that the automotive industry works closely (collaborates) with supply chain partners.

The results relating to relationships indicate that participants had good relationships with their supply chain partners. This result confirms the initial results of this study in sections 7.2.1 and 7.2.3. Disagreement with verifying BBBEE status as a challenge implies that local manufacturers in the South African automotive industry understand the application of the BEE policy and comply with law.

7.2.5.6 Production/skills challenges

In terms of production/skills challenge, the results show that ”reliable production schedules” were not a potential challenges as indicated by most (91.6%) of the respondents. The responses for “lack of capacity at production” were spread, with 41.7% of the respondents asserting that it was a challenge, 33.3% neither agreeing nor disagreeing and 25% disagreeing. The challenge of a “lack of skills” recorded a high agreement rating (58.4%), while a quarter (25%) felt it was not a challenge. Two-thirds of the respondents also felt “labour problems” were a challenge (66.7%).

According to the results, “unreliable production schedules” were not a major challenge. However, capacity, skills and labour issues were challenges impacting on the performance of local automotive manufacturers in South Africa. The results are in line with the findings of Naude and Badenhorst-Weiss (2011), who found that South African component manufacturers experience capacity limitations because of a lack of skilled labour. Another factor affecting South African OEMs is the time required to resolve labour disputes. The industry needs to try to raise labour productivity and skills levels. The respondents were requested to state other critical challenges that were not listed. Table 7.9 summarises the challenges identified by respondents.

Table 7.9: Summary of additional challenges identified by the respondents

* High overhead costs, low productivity compared with other plants
* Engineering challenges in terms of part modifications where we experience changes in the part while we have stock at sea freight
* Financially troubled suppliers
* Foreign exchange fluctuations
* Long lead time to transport vehicles from East London to Gauteng; poor road conditions. Regulations. All vehicles must be micro dotted (linked to VN number)
* Long lead times can lead to obsolete parts. Quality problems at suppliers. Tool breakdowns
* Market uncertainty with long reaction time

7.2.6 Complexity of overcoming challenges

The second part of question 4 required the respondents to rate the extent to which the agreed challenges were difficult to overcome. The responses were distributed using the following five-point Likert response format:

- 1: very easy to fix; few resources needed, little time or complexity
- 2: somewhat easy to fix, some resources and time needed, but not taxing for the enterprise
- 3: moderately difficult, can be remediated with moderate resources and time, moderate complexity;
- 4: somewhat difficult to fix, requires resources, time and is most likely complex
- 5: extremely difficult to fix, high impact on resources and time, extremely complex

As indicated earlier (sec 7.2.5), potential challenges were grouped into technological challenges, infrastructural challenges, cost challenges, market/service challenges, relationship challenges and skills challenges for the purpose of this analysis. The frequency distribution (in %) per statement is presented in table 7.10. For the purpose of analysis, the following abbreviations were used: E for very easy to fix; SE for somewhat easy to fix; M for moderate to difficult to fix; SD for somewhat difficult to fix; and ED for extremely difficult to fix.

Table 7.10: Complexity of overcoming challenges

Challenges	Agreed (%)	Complexity to overcome (%)				
		E	SE	M	SD	ED
Technological challenges						
We have inadequate information systems	25.0%	0.0%	8.3%	0.0%	0.0%	16.7%
We do not have an efficient planning and forecasting tool	25.0%	0.0%	8.3%	0.0%	0.0%	16.7%
We incur high cost when replacing obsolete assembly/manufacturing tools	83.3%	0.0%	0.0%	0.0%	75.0%	8.3%
Infrastructural challenges						
We do not have sustainable infrastructure	25.0%	0.0%	0.0%	0.0%	25.0%	0.0%
Rail transport is unreliable	50.0%	0.0%	0.0%	0.0%	33.3%	16.7%
Increased road freight volumes	66.7%	0.0%	16.7%	16.7%	25.0%	8.3%
We are challenged by delays at ports	91.7%	0.0%	8.3	0.0%	25.0%	58.3%
Cost challenges						
High fuel costs affect our operating cost	100.0%	0.0%	0.0%	8.3%	25.0%	66.7%
We have high operating costs	75.0%	0.0%	0.0%	8.3%	58.3%	8.3%
We incur high costs at South African ports	91.7%	0.0%	0.0%	16.7%	25.0%	50.0%
The prices of materials/components are high	66.7%	0.0%	0.0%	16.7%	33.3%	16.7%
Market/service challenges						
It is difficult finding new markets	58.3%	0.0%	0.0%	0.0%	33.3%	25.0%
Sometimes our customers cancel their orders	75.0%	0.0%	8.3%	16.7%	41.7%	8.3%
We are challenged to improve our service level	66.7%	0.0%	8.3%	33.3%	25.0%	0.0%
Relationship challenges						
It is difficult to verify the BEE status (scorecards) of our strategic suppliers	8.3%	0.0%	0.0%	8.3%	0.0%	0.0%
It is sometimes difficult to collaborate with our strategic suppliers	25.0%	0.0%	16.7%	8.3%	0.0%	0.0%
It is sometimes difficult to collaborate with our strategic customers	16.7%	0.0%	8.3%	8.3%	0.0%	0.0%
Production/skills challenges						
We have unreliable production schedules	8.3%	0.0%	0.0%	0.0%	0.0%	8.3%
We are challenged by a lack of capacity	41.7%	0.0%	0.0%	8.3%	8.3%	25.0%
We are challenged by a lack of skills	58.3%	0.0%	0.0%	0.0%	33.3%	25.0%
We are challenged by labour problems	66.7%	0.0%	0.0%	8.3%	41.7%	8.3%

(NB: Only the challenges that were difficult to overcome are discussed in this section; one respondent who agreed that labour problems were a challenge, did not indicate the complexity of overcoming the challenge.)

7.2.6.1 Complexity of overcoming technological challenges

(1) All of the 83.3% of respondents who said they incurred high costs when replacing obsolete assembly/manufacturing tools indicated that the problem was difficult to overcome. Three-quarters (75%) were of the opinion that this challenge was somewhat difficult to overcome and 8.3% were of the opinion that it was extremely difficult to overcome.

This shows that replacing obsolete assembly/manufacturing tools was the most difficult technological challenge to overcome.

7.2.6.2 Complexity of overcoming infrastructural challenges

(1) Regarding the challenge of unreliable rail transportation, 33.3% of the 50.0% of respondents, who indicated that this was a problem, said it was somewhat difficult to resolve, while 16.7% indicated that it was extremely difficult to sort out.
(2) Of the almost 66.7% of respondents who regarded “road freight volumes” as a problem, 16.7% noted that it is somewhat easy to resolve; 16.7% indicated that it was moderately difficult to sort out; 25% indicated that it was somewhat difficult to overcome; and 8.3% responded that it was extremely difficult to sort out.
(3) Almost all the respondents (above 90%) regarded “delays at port” as a problem. Of the respondents, 8.3% said it is easy to resolve; 25% that it was somewhat difficult to overcome; while over half (58.3%) said it was extremely difficult to sort out.

Delays at port and increases in road freight volume and unreliable rail were all mentioned as difficult challenges to overcome and were not within the control of automotive manufacturers.

7.2.6.3 Complexity of overcoming cost challenges

(1) All (100%) the respondents indicated that “high fuel costs” affect their operating costs. Only 8.3% of the respondents indicated that it the problem was moderately difficult to resolve; a quarter (25%) said it was somewhat difficult to resolve; while the majority (66.7%) suggested that it was extremely difficult to overcome,

(2) Of the respondents, 75.0% regarded “high operating costs” as a problem. A total of 8.3% indicated that it was moderately difficult to overcome this problem; more than half (58.4%) said that it was somewhat difficult to resolve; and only 8.3% indicated that it was extremely difficult to sort out.

(3) The majority (91.7%) of the respondents indicated that “incurring high costs at South African ports” was a problem. A total of 16.7% asserted that it was moderately difficult to sort out the problem; 25% said that it was somewhat difficult to resolve; and half (50%) indicated it was extremely difficult to overcome.

(4) Two-thirds (66.7%) of the respondents indicated that “prices of materials and components are high”. A total of16.7% said that this problem was moderately difficult to solve; 33.3% indicated that it was somewhat difficult to overcome; and 16.7% stated it was extremely difficult to sort out.

Overall, since cost challenges are beyond the control of automotive manufacturers, light vehicle manufacturers should concentrate on higher productivity and efficiency in the supply chain to make up for this uncontrollable situation.

7.2.6.4 Complexity of overcoming market/service challenges

(1) For 58.3% of the respondents “finding new markets” is a challenge. A third (33.3%) of the respondents indicated that the problem was somewhat difficult to overcome; and a quarter (25%) indicated that it was extremely difficult to resolve.

(2) For 75.0% of the respondents, “customers sometimes cancel their orders” posed a challenge. Only 8.3% of the respondents noted that it was somewhat easy to resolve the problem; 16.7% said that it was moderately difficult; 41.7% rated it as somewhat difficult to overcome; and 8.3% felt that it was extremely difficult to sort out.

(3) Two-thirds (66.7%) of the respondents indicated that “improving service levels” was a challenge. Only 8.3% held that the problem was somewhat easy to solve; a third (33.3%) said that it was moderately difficult to sort out; and 25% indicated that it was somewhat difficult to overcome.

The results show that automotive manufacturers do seem to have some control over the cancellation of orders and service levels. These challenges should therefore be the focus of manufacturers’ efforts to become more competitive.

7.2.6.5 Complexity of overcoming relationship challenges

Since none of the relationship-related issues were regarded as challenging, this issue does not justify further discussion.

7.2.6.6 Complexity of overcoming production/skills challenges

(1) A total of 58.3% of the respondents regarded "lack of skills" as a challenge. A third (33.3%) of them indicated that the problem was somewhat difficult to resolve, while a quarter (25%) said that it was extremely difficult to overcome..

(2) Again, 66.7% of the respondents indicated that "labour issues" posed a challenge. Only 8.3% indicated that it was moderately difficult to resolve this problem; more than a third (41.7%) indicated that it was somewhat difficult to overcome; and 8.3% indicated that it was extremely difficult to sort out.

This result shows that both labour issues and lack of skills appear to be difficult challenges to overcome. Skills development can only be fixed over the long term, which puts it somewhat more within the control of manufacturers compared to labour problems.

The results in table 7.10 show that some of the challenges in the South African automotive industry are complex and difficult to overcome. Regarding technological challenges, it is extremely difficult to reduce the high costs incurred to replace obsolete manufacturing tools. Infrastructural challenges are also extremely difficult to overcome (road freight volumes and delays at port). Manufacturers have little or no control over these challenges because the government is in charge of infrastructure development (Transnet). The majority of the respondents indicated that cost challenges (high fuel costs, high operating costs, high costs incurred at ports and high prices of materials) were somewhat difficult and sometimes extremely difficult to fix. This is understandable because the manufacturers are not the primary determinants of price, but the government and competitive position of the economy impact on cost dynamics in this case.

The respondents also rated the problem of finding new markets as somewhat and extremely difficult to resolve. These decisions are dependent on the competitive position of the local industry, compared with international automotive manufacturers, as well as the role of parent companies. Owing to the impact of the emerging economies, it is also difficult for South African automotive manufacturers to explore new markets abroad. Hence, it is suggested that the industry should endeavour to build and gain a competitive advantage in African markets. Furthermore, most of the respondents who agreed that sometimes customers cancel their orders, also stated that this was is a difficult challenge to overcome. Globalisation has caused this because nowadays, customers are spoilt for choice, and are suffering as a result of the worldwide recession that has plagued the globe for a number of years. Skills were identified as a major challenge that is somewhat and extremely difficult to fix. This is a national dilemma in South Africa and cannot be resolved in the short term by individual manufacturers. Labour issues were also acknowledged as difficult to sort out owing to the politicisation of the labour market and strict labour laws.

In summary, the radar graph below indicates the percentage of respondents who agreed that the statement was a challenge (blue line) and the chosen complexity of overcoming category for the majority of respondents who agreed that it was indeed a challenge (red line). This clearly indicates the challenges perceived by the majority of the respondents and the level of complexity of overcoming the problem. Figure 7.1 provides the radar graph.

Figure 7.1: Radar graph illustrating the complexity of overcoming challenges

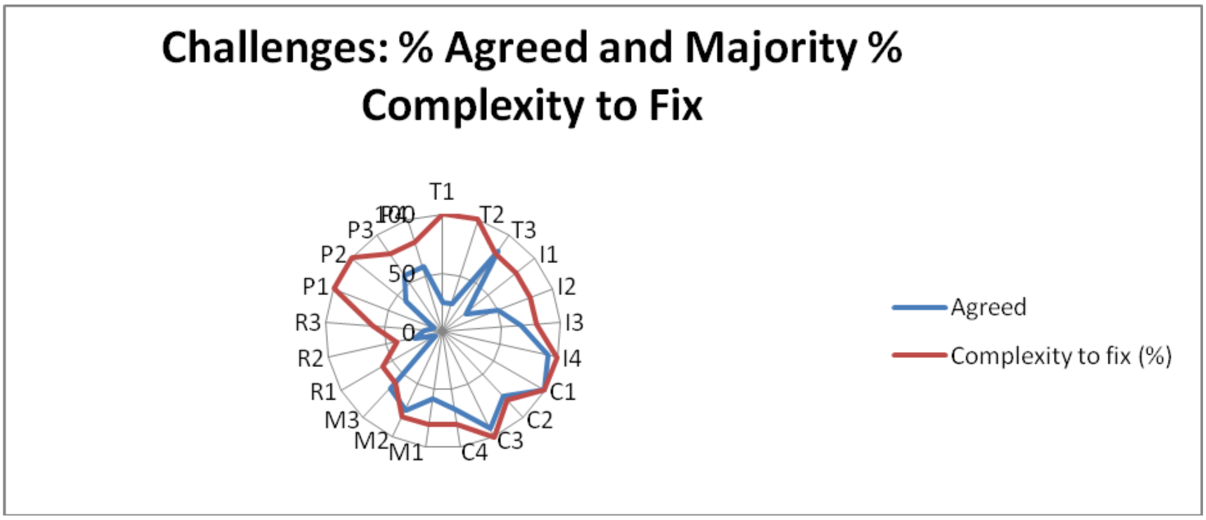


Table 7.11 below shows the description of the challenges illustrated in the graph.

Table 7.11: Description of the radar graph

Challenge	Description of challenge
Technological challenges	
T1	We have inadequate information systems
T2	We do not have an efficient planning and forecasting tool
T3	We incur high costs when replacing obsolete assembly/manufacturing tools
Infrastructural challenges	
I1	We do not have sustainable infrastructure
I2	Rail transport is unreliable
I3	Increased road freight volumes
I4	We are challenged by delays at ports
Cost challenges	
C1	High fuel costs affect our operating costs
C2	We have high operating costs
C3	We incur high costs at South African ports
C4	The prices of materials/components are high
Market/service challenges	
M1	It is difficult finding new markets
M2	Sometimes our customers cancel their orders
M3	We are challenged to improve our service levels
Relationships challenges	
R1	It is difficult to verify the BEE status (scorecards) of our strategic suppliers
R2	It is sometimes difficult to collaborate with our strategic suppliers
R3	It is sometimes difficult to collaborate with our strategic customers
Production/skills challenges	
P1	We have unreliable production schedules
P2	We are challenged by a lack of capacity
P3	We are challenged by lack of skills
P4	We are challenged by labour problems

For figure 7.1, the closer the blue line is to the centre, the less challenging the issue is, and the closer the red line is to the centre, the easier it is to resolve the problem. The radar graph clearly illustrates that the problems/challenges manufacturers encounter are difficult to extremely difficult to overcome and not really within their control.

7.2.7 Supply chain performance indicators

Section 7.2.7 deals with the respondents' views on the importance of key supply chain performance indicators that contribute to optimising their supply chain performance. Ten key performance indicators in SCM were listed, and the respondents were asked to rate the importance of each of the key indicators with a value between 0, indicating not important, to 100, indicating critically important. This question was semi-structured, and the open-ended section required respondents to state the key reasons for their rating. Table 7.12 shows the rating of the key supply chain performance indicators in order from the highest to the lowest average importance.

Table 7.12: Response regarding supply chain performance indicators

Supply chain indicators	**N**	**Mean**	**Median**
Quality (meeting quality standards of the vehicle)	12	90.83	92.50
Final product delivery reliability (delivery of the right vehicle at the right time to customers)	12	86.25	90.00
Cost (associated with producing the vehicle)	12	85.00	87.50
Supplier reliability (we rely on the effectiveness of our suppliers)	12	85.00	90.00
Order delivery lead time (time taken to complete all activities from order to delivery)	12	79.58	80.00
Responsiveness (how quickly vehicles are delivered to customers)	12	76.25	75.00
Flexibility (ability to respond to changing needs of customers)	12	74.17	80.00
Supply chain asset management (effectiveness of managing assets to support demand satisfaction)	12	72.08	77.50
Product variety (variety of models of the vehicle offered to the market)	12	71.25	80.00
Innovation (radical and incremental changes in the vehicle production process)	12	67.50	72.50

Table 7.12 indicates that, overall, quality was considered the most important performance indicator (a mean of 90.83), followed by final product delivery reliability (a mean of 86.25) and then cost and supplier reliability (a mean of 85.00). Innovation and product variety were rated the lowest, which may be explained by the fact that most of the vehicle models made in South Africa are low-cost and standard vehicles. Hence there is a limited variety of production models and little or no radical change in the production process.

Respondents were requested to indicate the reasons for their ratings. Table 7.13 summarises the responses. These are categorised into competition, quality, cost, export and lead time.

Table 7.13: Key reasons for rating of supply chain performance indicators

Category of rating	Reasons
Competition	"Based on the competitiveness of the industry, we benchmark our brand to exceed the expectations of our competitors"; "We are in competition against Russian, Chinese and Indian plants for new business ... they are very cost effective"
Quality	"We focus on quality vehicles to customers"; "Quality is an essential requirement, even if it costs more"; "The mission of the group is to supply quality vehicles to customers"; "We do not compromise quality for cost"
Cost	"Cost and on-time delivery are a key requirement"; "Low cost model, focus is on quality and reliability". "Cost is more important than the nice to have"; "Pay more attention to cost and quality than others"
Lead time	"Ensuring export deliveries on time while maintaining our profit margin"; "Lead time reduction prioritised to increase free car flows"

7.2.8 Supply chain performance indicator rating per manufacturer

Table 7.14 indicates the mean values for supply chain performance indicators according to manufacturers. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 7.14: Key supply chain performance indicators by manufacturers

Supply chain indicators	Mean					
	E1	AM	E2	A1	A2	E3
Quality	82.50	80.00	70.00	91.25	75.00	92.50
Final product delivery reliability	97.50	80.00	95.00	87.50	90.00	100.0
Cost	95.00	42.50	80.0	78.75	50.00	85.00
Supplier reliability	87.50	72.50	95.00	91.25	60.00	90.00
Order delivery lead time	95.00	37.50	90.00	60.00	60.00	77.50
Responsiveness	90.00	55.00	90.00	78.75	70.00	75.00
Flexibility	90.00	62.50	90.00	85.00	75.00	72.50
Supply chain asset management	95.00	77.50	95.00	93.75	75.00	72.50
Product variety	95.00	37.50	80.00	72.50	60.00	80.00
Innovation	87.50	50.00	80.00	77.50	40.00	80.00

As indicated in table 7.14, the following discussions reflect the manufacturers' perspectives on supply chain indicators:

1) The most implemented indicator for European manufacturer 1 was final delivery reliability (a mean of 97.50) followed by cost, order delivery lead time and product variety (a mean of 95.00). The lowest rating was recorded for quality (a mean of 82.50), but since this value was still above 80, it clearly indicates that all of these indicators were considered important for optimising supply chain performance.
2) For the American manufacturer, quality and final delivery reliability were the most important indicators (a mean of 80.00), followed by supply chain asset management (a mean of 77.50). The least implemented indicator was order delivery lead time and product variety (a mean of 37.50), clearly indicating that the indicators were not that important in optimising supply chain performance.
3) The most implemented indicator for European manufacturer 2 was final product delivery reliability, supplier reliability and supply chain asset management (a mean of 95.00). The lowest mean value of 70.00 was recorded for quality, indicating that it was not critically important, but still fairly important for optimising supply chain performance. It is interesting to note that for both European manufacturers 1 and 2, quality was rated as the lowest value, but it was still above 70.
4) For Asian manufacturer 1, supply chain asset management was the most important indicator (a mean of 93.75), followed by quality and supplier reliability (means of 91.25). The least important indicator was order delivery lead time (a mean of 60.00).

5) According to Asian manufacturer 2, final delivery reliability was the most important indicator (a mean of 90.00), followed by quality, flexibility and supply chain asset management (a mean of 75.00). The least implemented indicator was innovation (a mean of 40.00).
6) Final delivery reliability was the most important indicator for European manufacturer 3 (a mean of 100.0), followed by quality (a mean of 92.50). Flexibility and supply chain asset management were considered the least important (a mean of 72.50).

Quality was not as important an indicator for European manufacturers 1 and 2 as it is for the Asian manufacturers. European manufacturers 1 and 2 rated order delivery lead time, responsiveness and flexibility very high with a mean ranging from 90.00 to 95.00, while these were not the most important indicators for Asian manufacturers. The highest rating for the indicators was final product reliability by European manufacturer 3 (a mean of 100.00), while order delivery lead time and product variety recorded the lowest rating by the American manufacturer (a mean of 37.50) indicating that it was of little importance. The results also show that all the indicators were very important for optimising supply chain performance for European manufacturers compared to the Asian and American manufacturers, indicating that European manufacturers exhibited some important characteristics of a responsive supply chain (agile).

7.2.9 Testing differences between parent company of origin with regard to supply chain best practices

In this subsection, the differences between the manufacturers based on the origin of their parent companies are discussed. The question could shed light on the possible different management cultures or styles typical in certain countries or continents. The Mann-Whitney U test was used. It is the nonparametric counterpart of the t-test for independent groups without the t-test's limiting assumptions (Welman, Kruger & Mitchell 2007:230; Blumberg, Cooper & Schindler, 2006:580). The test was used because of the small sample size and the data type (ordinal).

7.2.9.1 Supply chain best practices (inbound, outbound and internal supply chain)

The Mann-Whitney U test was conducted to see whether there was a significant difference between the parent company's continent origin (Asia and Europe) with regard to their supply chain practices. In South Africa, the big three automotive nations are represented, emanating from Asia, Europe and America. The test did not include the American manufacturers because only one was represented in the study.

The hypotheses tested for the supply chain practices are:

H_0: Local manufacturers of light vehicles of Asian and European parent company origin do not differ statistically significantly with regard to implementing supply chain best practices.
H_1: Local manufacturers of Asian and European parent company origin do differ statistically significantly with regard to implementing supply chain best practices.

With regard to the implementation of supply chain best practices, no statistically significant differences were found between local manufacturers of European and Asian parent company origin with the exception of a few best practices. Table 7.15 reflects the statements in which there was a statistically significant difference, at the 5% level of significance, between OEM continent origin (Asia and Europe) with regard to implementing supply chain best practices.

Table 7.15: Mann-Whitney test: significant differences in supply chain best practices

Supply chain practices	**Mean rank**	**p-value**
Inbound supply chain practices		
We have long-term relationships with our strategic suppliers	Asia = 4.00 Europe = 7.00	.050
We cooperate with our strategic suppliers to improve processes	Asia = 3.50 Europe = 7.50	.017
We have trusting relationship with our strategic suppliers	Asia = 3.60 Europe = 7.40	.031
Outbound supply chain practices		
We share supply chain risks with our strategic customers	Asia = 3.70 Europe = 7.30	.049
Internal supply chain practices		
We share relevant information with other departments	Asia = 4.00 Europe = 7.00	.050

With regard to inbound supply chain best practices, the local manufacturers of European origin (mean rank of 7.00) implemented long-term relationships with their strategic suppliers to a greater extent compared to manufacturers of Asian origin (mean rank of 4.00). European manufacturers (mean rank of 7.50) also cooperated with their strategic suppliers to improve processes to a greater extent than Asian manufacturers (mean rank of 3.50). Also, European manufacturers (mean rank of 7.40) implemented a trusting relationship with their strategic suppliers to a greater extent than Asian manufacturers (mean rank of 3.60).

These results indicate that light vehicle manufacturers of European origin implement inbound supply chain practices to a greater extent compared with Asian manufacturers.

With reference to the outbound supply chain, European manufacturers (mean rank of 7.3) share supply chain risks with their strategic suppliers to a greater extent than Asian manufacturers (mean rank of 3.70).

Also, with regard to internal supply chain, European manufacturers (mean rank of 7.00) share relevant information with other departments to a greater extent compared to their Asian counterparts (mean rank of 4.00).

Asian manufacturing companies are well known for cooperation and collaboration with their supply chain partners, particularly with their suppliers. This part of the study shows that in certain aspects of supply chain best practices, European companies show significantly better supply chain best practices than their Asian counterparts.

7.2.9.2 Supply chain challenges

The Mann-Whitney U test was also conducted to see whether there was a statistically significant difference between parent company continent origin (Asia and Europe) with regard to how they perceive supply chain challenges. The hypotheses tested for supply chain challenges were as follows:

H_0: Local manufacturers of light vehicles of Asian and European origin do not differ statistically significantly with regard to the way they perceive supply chain challenges.
H_1: Local manufacturers of Asian and European origin differ statistically significantly with regard to the way they perceive supply chain challenges.

Local manufacturers of light vehicles of European and Asian origin scored similar results for SCM challenges, except for three. Table 7.16 reflects the statements in which statistically significant differences, at the 5% level of significance, were found between OEM continent origin (Asia and Europe) with regard to supply chain challenges.

Table 7.16: Mann-Whitney test: significant differences in views on supply chain challenges

Challenges	Mean rank	p-value
We have inadequate information systems	Asia = 7.50 Europe = 3.50	.018
Rail transport is unreliable	Asia = 3.20 Europe = 7.80	.013
We are challenged by labour problems	Asian = 7.40 Europe = 3.60	.034

As indicated in table 7.16, at the 5% significance level, there was a statistically significant difference in the way European and Asian manufacturers perceived these three key supply chain challenges. Furthermore, Asian manufacturers (Mean rank of 7.50) tended to agree that inadequacy of their information systems was a challenge compared to European manufacturers (mean rank of 3.50). Asian manufacturers also tended to agree (mean rank of 7.40) that labour problems were a challenge compared to their European counterparts (mean rank of 3.60). European manufacturers, however, seemed to agree (mean rank 7.80) that rail transport was unreliable.

With regard to their opinions on labour problems, no explanation would be possible without further investigation. The difference regarding unreliable rail transport could be explained by location of the companies, but this topic would certainly require further investigation.

7.2.9.3 Importance of supply chain performance indicators

The Mann-Whitney U test was conducted to see whether there was a statistically significant difference between the parent company's continent origin (Asia and Europe) with regard to their view on the importance of supply chain performance indicators in contributing to optimisation of the supply chain.

The hypotheses tested for the importance of supply chain performance indicators were as follows:

H_0: Local manufacturers of light vehicles of Asian and European origin do not differ statistically significantly with regard to their view on the importance of supply chain performance indicators.
H_1: Local manufacturers of Asian and European origin differ statistically significantly with regard to their view on the importance of supply chain performance indicators.

It was found that local manufacturers of European and Asian origin agreed to a large extent on the importance of key performance indicators regarding supply chain, except for a few. Table 7.17 reflects the statements in which there were statistically significant differences, at the 5% level of significance.

Table 7.17: Mann-Whitney test: significant differences in supply chain indicators

Supply chain indicators	Mean rank	p-value
Final product delivery reliability (delivery of the right vehicle at the right time to customers)	Asia = 3.20 Europe = 7.80	.013
Order delivery lead time (time taken to complete all activities from order to delivery)	Asia = 3.40 Europe = 7.60	.027

Final product delivery reliability and order delivery lead time tended to be more important in contributing to optimising supply chain performance for European manufacturers (mean rank of 7.80 and 7.60 respectively) compared to Asian manufacturers (mean ranks of 3.20 and 3.40 respectively). This result attests to the fact that competitiveness in cost; quality and product offerings are critical issues for all manufacturers in the automotive industry.

7.2.10 Summary of results for supply chain best practices

This subsection summarises the results in relation to inbound supply chain practices, supply chain challenges and performance indicators.

7.2.10.1 Supply chain best practices

Across the supply chain, supply chain best practices were implemented to a great extent. Highly/top rated practices were “building long-term relationships”, “cooperation to improve process” and “collaboration on new product development” (means of 4.25 to 4.58). “Sharing supply chain risk” received the lowest mean rating across the inbound, outbound and internal supply chain (means of 3.17 to 3.75). In both the inbound and outbound supply chain best practices, “building long-term relationships” was the most implemented practice (means of 4.58 and 4.33 respectively). “Cooperation to improve processes and operations” was among the top five most implemented practices of inbound supply chain (means of 4.42 to 4.50). However, it was actually the least implemented best practice with strategic customers (means of 3.67 to 3.83). This implies that there is still evidence of a silo mentality on the customer side of the supply chain. It is thus clear that integration across the supply chain is not fully actualised. Across the supply chain, all the manufacturers perform better with their strategic suppliers compared to their strategic customers.

7.2.10.2 Supply chain challenges

It was clear from the literature that the automotive industry is important to the South African economy. However, it faces enormous challenges. Table 7.18 summarises the results for challenges facing the South African automotive supply chain (only where there was more than 50% agreement that it is a challenge). Most of the important challenges that exist are to a great extent not within control of individual manufacturers or the industry as a whole. They are thus difficult to overcome.

Table 7.18: Challenges facing the South African automotive industry

Challenges	(%) of agreement	% Difficult to fix
Technological challenges		
We incur high costs when replacing obsolete assembly/manufacturing tools	83.3%	83.3%
Infrastructural challenges		
Increased road freight volumes	66.7%	50%
We are challenged by delays at ports	91.7%	83.4%
Cost challenges		
High fuel costs affect our operating costs	100.0%	100%
We have high operating costs	75.0%	75%
We incur high costs at South African ports	91.7%	91.7%
The prices of materials/components are high	66.7%	66.7%
Market/service challenges		
It is difficult finding new markets	58.4%	58.4%
Sometimes our customers cancel their orders	75.0%	66.7%
We are challenged to improve our service levels	66.7%	58.3%
Production/skills challenges		
We are challenged by lack of skills	58.3%	58.3%
We are challenged by labour problems	66.7%	50.0%

Light vehicle manufacturers should first focus on challenges that are easy to overcome because they require less effort. Most of the main problems mentioned in table 7.18 such as road freight volumes, delays at port, unreliability of rail, high fuel costs, high operating costs, high costs at ports and high prices of materials are actually difficult to resolve and beyond the control of manufacturers. However, a few of the challenges that are difficult to overcome are actually avenues for manufacturers to focus their efforts to become more competitive, such as replacing outdated assembly/manufacturing tools and finding new markets. Cancellation of customer orders and improving service levels are relatively easier to overcome and could be a starting point for improvement.

7.2.10.3 Supply chain performance indicators

The results reveal that overall, "quality" was considered the most important performance indicator (a mean of 90.83), followed by "final product delivery reliability" (a mean of 86.25) and then cost (85.00) and "supplier reliability" in contributing to the optimisation of automotive industry supply chain performance. "Innovation" and "product variety" were rated the lowest. The results also show that all the indicators were more important for optimising supply chain performance for European manufacturers compared to Asian and American manufacturers. This indicates that European manufacturers exhibit some vital characteristics of a responsive supply chain (agile).

7.3 SUPPLY CHAIN STRATEGIES

The second part of the interview questionnaire examined supply chain strategies. This section seeks to determine supply chain strategies based on product characteristics, manufacturing characteristics and the decision drivers of SCM. As indicated in section 7.2, supply chain strategies are based on a particular model (car) or production line. The findings relating to strategies should therefore be interpreted for the particular model and are not necessarily applicable to other models manufactured by the same company.

7.3.1 Determining supply chain strategies based on product characteristics

In this question, respondents were asked to rate their agreement on statements relating to the product (car model) characteristics using a five-point Likert response format from 1 (strongly disagree) to 5 (strongly agree). The questions comprised five statements and the results are presented using percentages. Table 7.19 indicates the frequency distribution (in %) per statement. For the purposes of analysis the following abbreviations were used: *SD* for strongly disagree; *D* for disagree; *N* for neither agree nor disagree; *A* for agree; and *SA* for strongly disagree.

Table 7.19: Responses regarding product characteristics

Statements	Percentage				
	SD	D	N	A	SA
The model is a standard vehicle (no customisation)	25.0%	25.0%	0.0%	33.3%	16.7 %
The demand for the model (vehicle) is stable	8.3%	8.3%	0.0%	75.0%	8.3%
The market winner (most important sales criteria/point) for the model is cost	16.7%	33.3%	8.3%	16.7%	25.0 %
The order lead time (order to delivery) takes more than three months	16.7%	50.0%	25.0%	8.3%	0.0%
Our forecast for the model is relatively accurate	8.3%	0.0%	16.7%	75.0%	0.0%

According to table 7.19, for half of the respondents the model (car) chosen for the study was a standard vehicle (50.0%). The majority (83.3%) of the respondents agreed that the demand for the model was stable. Half (50.0%) of the respondents disagreed that the market winner (most important sales criteria/point) for the model was cost, while 41.7% agreed. These results mean that South African automotive manufacturers not only assemble standardised vehicles. Two-thirds (67.7%) of the respondents disagreed that the order lead time (order to delivery) took more than three months. In addition, three-quarters (75.0%) of the respondents agreed that their forecast for the model was relatively accurate. Most of the products thus had a relatively stable demand as well as relatively accurate forecasting for their models. Hence the industry manufactures both functional (standard) and innovative (nonstandardised) products, implying this study includes both lean and agile supply chain strategies followed by manufacturers.

7.3.2 Product characteristics by manufacturer

This section of the results presents the mean level of agreement of the manufacturers on product characteristics. Table 7.20 presents the mean level of agreement of the respondents regarding product characteristics. For the purposes of analysis, the following abbreviations were used: *E1* for European manufacturer 1; *E2* for European manufacturer 2; *E3* for European manufacturer 3; *AM* for American manufacturer; *A1* for Asian manufacturer 1; and *A2* for Asian manufacturer 2.

Table 7.20: Responses regarding product characteristics by manufacturer

Statements	Mean level of agreement					
	E1	AM	E2	A1	A2	E3
The model is a standard vehicle (no customisation)	1.00	4.50	2.00	3.25	4.00	2.50
The demand for the model (vehicle) is stable	2.50	4.50	4.00	4.00	4.00	3.00
The market winner (most important sales criterion/point) for the model is cost	2.00	5.00	2.00	3.75	1.00	2.00
The order lead time (order to delivery) takes more than three months	1.50	2.00	2.00	3.00	2.00	2.00
Our forecast for the model is relatively accurate	2.00	3.50	4.00	4.00	4.00	4.00

The results in table 7.20 indicate that, on average, European manufacturers 1, 2 and 3 tended to disagree that the model was a standard vehicle (means of 1.00, 2.00 and 2.50 respectively), while the American manufacturer and Asian manufacturer 2 agreed (means of 4.50 and 4.00 respectively). Most of the manufacturers (American manufacturer, European manufacturer 2 and Asian manufacturers 1 and 2) agreed that demand for the vehicle was stable. The American manufacturer strongly agreed that the market winner for the vehicle was cost (a mean of 5.00), while four of the manufacturers (European manufacturers 1, 2 and 3 and Asian manufacturer 2) disagreed that the market winner was cost (a mean of 1.00 to 2.00). The majority of the manufacturers did not agree that the order lead time for the product wass more than three months (means of 1.00 to 2.00). European manufacturer 1 disagreed that it implements relatively accurate forecasting (mean of 2.00), while most of the manufacturers agreed that they did (mean of 4.00).

The result shows that all the European manufacturers' (1, 2 and 3) models were not standard products (functional). While the E2 model was not a functional product, the demand for the vehicle was stable - hence a mismatch in the product characteristics. All the manufacturers agreed, on average, that the order delivery lead time took less than three months.

7.3.3 Determining supply chain strategies based on manufacturing characteristics

The respondents' perceptions were sought on manufacturing characteristics. This question comprised seven statements and was measured using a five-point Likert response format, ranging from 1 (strongly disagree) to 5 (strongly agree). For convenience of presentation of the analysis, the following abbreviations were used: *SD* for strongly disagree; *D* for disagree; *N* for neither agree nor disagree; *A* for agree; and *SA* for strongly disagree. The analysis is presented in percentages. Table 7.21 indicates the frequency distribution (in % responses) per statement.

Table 7.21: Responses regarding manufacturing characteristics

Statements	Percentage				
	SD	D	N	A	SA
We have a low manufacturing cost strategy	8.3%	8.3%	8.3%	50.0%	25.0%
We make provision in our manufacturing strategy for customers' demands (specifications)	0.0%	8.3%	8.3%	50.0%	33.3%
We change our manufacturing strategy quickly according to customer demands	8.3%	33.3%	16.7%	41.7%	0.0%
We customise some parts in our production process to meet certain customers' orders	16.7%	25.0%	8.3%	33.3%	16.7%
We keep minimum inventory in the production process	0.0%	0.0%	16.7%	33.3%	50.0%
We manufacture on the basis of projected forecast	0.0%	0.0%	0.0%	66.7%	33.3%
We have a pull system with specific customer orders	8.3%	16.7%	8.3%	33.3%	33.3%

Table 7.21 indicates that three-quarters (75.0%) of the respondents agreed or strongly agreed that the model had a low manufacturing cost strategy. The majority (83.3%) of the respondents agreed that they made provision in their manufacturing strategy for customers' demands (specifications) for the model. Regarding the statement to determine whether the respondents' change their manufacturing strategy quickly according to customer demands for the model, 41.7% of the respondents agreed, while 41.7% disagreed. Half (50%) of the respondents agreed that some parts in the production process for the model were customised to meet certain customers' orders, while 41.7% disagreed. The majority (83.3%) of the respondents indicated that they kept minimum inventory in the production process for the model. All the respondents (100.0%) indicated that the model was manufactured on the basis of the projected forecast. Two-thirds (66.7%) of the respondents agreed that the model had a pull system with specific customer orders, while a quarter (25.0%) disagreed.

The results show that the majority of the respondents followed a low manufacturing cost strategy for the production line. Hence the focus of the manufacturing process was on reducing waste while enhancing customer value (lean supply chain). Also, to some extent the manufacturers followed a make-to-order (MTO) strategy based on demands from dealers. The manufacturers kept minimum inventory in the production process (lean supply chain strategy). The manufacturing process was based on projected forecast. The majority of the respondents used a pull system.

In order to further understand the manufacturing strategy, the respondents were asked to state which of the following strategies they used in the production line of the model, as reflected in table 7.22.

Table 7.22: Strategy used in the production line

Which of the following manufacturing strategies best suit the production line for this model?	**Percentage**
Make-to-stock (MTS)	58.3%
Make-to-order (MTO)	41.7%

As indicated in table 7.22, more than half of the respondents (58.3%) indicated that the manufacturing strategy that best suited the production line (model) was a make-to-stock strategy, while 41.7% indicated that make-to-order was the strategy. The make-to-stock strategy was implemented slightly more, indicating that a lean supply chain was the dominant strategy.

7.3.4 Responses regarding manufacturing characteristics by manufacturers

This part of the results deals with the responses on manufacturing characteristics according to the manufacturers. The results are presented using mean level of agreement scores as indicated in table 7.23. For the purposes of analysis, the following abbreviations were used: *E1* for European manufacturer 1; *E2* for European manufacturer 2; *E3* for European manufacturer 3; *AM* for American manufacturer; *A1* for Asian manufacturer 1; and *A2* for Asian manufacturer 2.

Table 7:23: Responses regarding manufacturing characteristics by manufacturers

Statements	Mean level of agreement					
	E1	**AM**	**E2**	**A1**	**A2**	**E3**
We have a low manufacturing cost strategy	3.00	5.00	4.00	4.50	4.00	2.50
We make provision in our manufacturing strategy for customers' demands (specifications)	4.00	4.50	5.00	3.75	2.00	4.00
We change our manufacturing strategy quickly according to customer demands	4.00	3.00	4.00	2.25	2.00	3.00
We customise some parts in our production process to meet certain customers' orders	4.50	1.50	5.00	3.00	1.00	3.50
We keep minimum inventory in the production process	3.50	4.50	4.00	4.50	5.00	4.00
We manufacture on the basis of projected forecast	4.00	4.50	4.00	4.50	5.00	4.00
We have a pull system with specific customer orders	5.00	3.00	5.00	3.25	2.00	4.00

As indicated in table 7.23, the American manufacturer, European manufacturer 2 and Asian manufacturers 1 and 2 agreed that they employed a low manufacturing cost strategy (means of 4.00 to 5.00). Asian manufacturer 2 disagreed that it *made provision* in the manufacturing strategy for customers' demands (specifications) (mean of 2.00). The European manufacturers (1 and 2) were the only manufacturers that agreed that they *changed* their manufacturing strategy quickly according to customer demands (a mean of 4.00), while the Asian manufacturers disagreed that they implemented this practice (mean of 2.00 and 2.25). European manufacturers 1 and 2 agreed that they customised some parts of their production process to meet certain customers' orders (mean scores of 4.50 and 5.00 respectively), while the American manufacturer and Asian manufacturer 2 disagreed that they implemented the practice (means of 1.00 and 1.50 respectively). Asian manufacturer 2 recorded the highest mean value of 5.00 for keeping minimum inventory in the production process and also the highest mean value of 5.00 for manufacturing based on projected forecast. Only Asian manufacturer 2 did not agree that it had a pull system with specific customer orders (a mean of 2.00), indicating a lean supply chain strategy.

From the results, it is clear that all the manufacturers, except European manufacturer 1 and 3 followed a low manufacturing cost strategy, indicating that both lean and agile supply chain strategies were used. All the manufacturers except Asian manufacturer 2 made provision for changes in their manufacturing. Also all the manufacturers except Asian manufacturers 1 and 2 actually changed their manufacturing strategy to meet customer demand. These changes indicate an agile supply chain strategy. Hence some used a MTS strategy, for example, low manufacturing cost, keeping minimum inventory, while others adopted an MTO strategy, such as changing manufacturing strategies according to customers' demand. It is thus clear that both lean and agile supply chain strategies were evident in these locally manufactured models.

7.3.5 Postponement characteristics

Statements relating to postponement were also used to establish the relationships between manufacturing characteristics and supply chain strategies. A postponement strategy shows the position (decision point) where a strategy changes from one to another (from a lean to agile supply chain). The respondents were asked about their level of agreement on the application of postponement by means of six statements using a five-point Likert response format, ranging from 1 (strongly disagree) to 5 (strongly agree). For convenience of presentation of the analysis, the following abbreviations were used: *SD* for strongly disagree; *D* for disagree; *N* for neither agree nor disagree; *A* for agree; and *SA* for strongly disagree. Table 7.24 indicates the frequency distribution (in %) per statement.

Table 7.24: Responses regarding postponement characteristics

Statements	Percentage				
	SD	D	N	A	SA
Our strategic suppliers keep inventory in the form of modules, components and materials	0.0%	0.0%	0.0%	83.3%	16.7%
We keep fully assembled vehicles in stock (assembled vehicles)	8.3%	0.0%	8.3%	75.0%	8.3%
Our dealers keep fully assembled vehicles in stock	0.0%	0.0%	0.0%	66.7%	33.3%
We keep work-in-progress inventory to be customised for specific customer orders	16.7%	41.7%	16.7%	25.0%	0.0%
We only order modules, components and materials from our strategic suppliers when the customer specifications are known	16.7%	8.3%	0.0%	50.0%	25.0%
We make provision for finalisation of some features to our vehicles at the dealership, based on final customer requests	33.3%	0.0%	8.3%	8.3%	50.0%

Table 7.24 reveals that all the respondents (100%) agreed that their strategic suppliers kept inventory in the form of modules, components and materials. Furthermore, the majority of the respondents (83.3%) agreed that fully assembled models of the vehicles were kept in stock. All the respondents (100.0%) agreed that their strategic customers (dealers) kept fully assembled vehicles in stock. More than half (58.4%) of the respondents disagreed that they kept work-in-progress inventory to be customised for specific customer orders, while only a

quarter (25.0%) agreed. Three-quarters of the respondents (75.0%) agreed that modules, components and materials are only ordered from strategic suppliers when the customer specifications were known. More than half (58.3%) of the respondents agreed that they made provision for finalisation of some features to their vehicles at the dealership based on final customer requests, while a third (33.3%) strongly disagreed.

It is thus clear that strategic suppliers keep inventory in the form of modules, components and materials, and most manufacturers keep fully assembled vehicles in stock (83.3% agreement). At some manufacturers, work-in-progress inventory is kept in stock by most manufacturers indicating that a decision about final assembly is made at the manufacturer (decoupling point), based on final customer requirements, thus implying the use of a lean and agile (leagile) supply chain strategy. Overall, the findings suggest that the majority of the respondents used some form of postponement, which indicates an element of agility – hence the use of a leagile supply chain.

7.3.6 Responses regarding postponement by manufacturer

To gain a further understanding of how different manufacturers apply postponement practices, the responses were analysed according to the mean level of agreement per manufacturer. Table 7.25 presents the responses. For purposes of analysis, the following abbreviations were used: *E1* for European manufacturer 1; *E2* for European manufacturer 2; *E3* for European manufacturer 3; *AM* for American manufacturer; *A1* for Asian manufacturer 1; and *A2* for Asian manufacturer 2.

Table 7.25: Responses regarding postponement by manufacturer

Statements	Mean level of agreement					
	E1	AM	E2	A1	A2	E3
Our strategic suppliers keep inventory in the form of modules, components and materials	4.00	4.50	4.00	4.00	4.00	4.50
We keep fully assembled vehicles in stock (assembled vehicles)	2.50	4.50	4.00	3.75	4.00	4.00
Our dealers keep fully assembled vehicles in stock	4.50	4.50	4.00	4.25	5.00	4.00
We keep work-in-progress inventory to be customised for specific customer orders	3.50	1.50	4.00	2.75	1.00	2.00
We only order modules, components and materials from our strategic suppliers when the customer specifications are known	4.50	3.00	4.00	2.75	4.00	4.50
We add some features to our vehicles at the dealership, based on final customer requests	1.00	3.00	5.00	4.25	5.00	3.00

As indicated in table 7.25, overall, all the manufacturers, on average, agreed that their strategic suppliers kept inventory in the form of modules, components and material (means of 4.00 to 4.50). European manufacturers 2 and 3, Asian manufacturer 2 and the American manufacturer agreed, on average, that they kept fully assembled vehicles in stock (assembled vehicles) (means of 4.00 to 4.50), while European manufacturer 1 disagreed on implementing this practice (a mean of 2.50). All the manufacturers indicated, on average, that their dealers kept fully assembled vehicles in stock, indicating a lean supply chain. European manufacturers 1 and 2 were, on average, the only manufacturers that kept work-in-progress inventory to be customised for specific customer orders (means of 3.50 and 4.00 respectively), while the other manufacturers disagreed, on average, to implementing the practice (means of 1.00 to 2.75). Only the American manufacturer disagreed that it only ordered modules, components and materials from its strategic suppliers when the customer specifications were known (a mean of 2.75), while four of the other five manufacturers agreed, on average, to implementing the practice (means of 4.00 to 4.50). Three of the manufacturers (European manufacturer 2, Asian manufacturers 1 and 2) agreed, on average, that they made provision for adding some features to the vehicles at the dealership based on customer requests (means of 4.25 to 5.00), while European manufacturer 1 disagreed to implementing the practice (a mean of 1.00).

The results show that European manufacturer 1 did not keep fully assembled vehicles in stock, indicating a MTO strategy (agile supply chain). Only European manufacturers 1 and 2 tended to keep work-in-progress inventory - hence a point where the lean supply chain changes to agile supply chain. The results provide evidence of some form of postponement practice followed by the manufacturers. Therefore, although some supply chains were mainly lean, they may have applied some agile elements at different points in the supply chain.

7.3.7 Determining supply chain strategies based on the decision drivers of SCM

The respondents were asked to indicate the extent to which they agreed with statements relating to production, inventory, location, transportation, information, supplier selection and pricing decisions. A five-point Likert response format with end points 1 (no extent) to 5 (very great extent) was used and the mean and median results are presented in table 7.26.

Table 7.26: Responses regarding decision drivers of the supply chain

Statements		Mean	Median
Production	We have excess capacity in our production process	2.92	3.00
	We have flexible manufacturing processes	2.91	3.00
Inventory	We work on a strict JIT system and therefore keep inventory holding in the production process to a minimum	4.17	4.00
Location	We have decentralised distribution centres (stores) to serve our dealers	2.75	2.00
	Our local strategic suppliers are located close to our production plant	3.67	3.50
Transportation	We make small and frequent shipments to our strategic customers	4.25	4.00
	We receive small and frequent shipments from our strategic suppliers	3.92	4.00
	We make use of the low cost mode of transportation for parts purchase from our strategic suppliers	3.83	4.00
	We make use of the low cost mode of transportation for vehicles to our dealers	3.50	4.00
Information	Information helps us to build master production schedule (forecasts) and create delivery dates	4.58	5.00
	Information is used on actual demand to be transmitted quickly to reflect real demand accurately	3.92	4.50
Supplier selection	We select suppliers based on low price/cost	3.83	4.00
	We select suppliers on the basis of high quality standards	4.42	4.50
	We select suppliers on the basis of dependability/sustainability	3.75	3.50
	We select suppliers on the basis of flexibility	3.42	3.50
Pricing strategy	Our pricing strategy is determined by balancing supply and demand	3.42	3.50
	Our pricing strategy is based on low margins (low margins based on high volume)	2.58	3.00
	Our pricing strategy is based on differentiation in the market	2.83	3.50

- ***Production.*** The results indicated that manufacturers tended to implement excess capacity and flexible manufacturing (means of 2.92 and 2.91 respectively) to a moderate extent, which indicated a lean supply chain. An agile supply chain is characterised by excess capacity and flexibility.

- ***Inventory.*** With regard to inventory, the respondents indicated that they implemented the practice of working on a strict JIT system and keeping inventory holding in the production process to a minimum, to a great extent (a mean of 4.17). A strict JIT system is a characteristic of a lean supply chain strategy.

- ***Location.*** Respondents tended to use decentralised distribution centres (stores) to serve dealers to a moderate extent (a mean of 2.75). Local strategic suppliers tended to be located close to the production plant to a greater extent (a mean of 3.67). Decentralised distribution centres and strategic suppliers close to the manufacturers indicate a responsive (agile) supply chain strategy.

- ***Transportation.*** The results show that frequent shipments to strategic customers were done to a great extent (a mean of 4.25). Also, manufacturers tended to receive, on average, small and frequent shipments from their strategic suppliers (a mean value of 3.92). Moreover, the low cost mode of transportation for parts purchased from their strategic suppliers tended to be used to a great extent (mean of 3.83). Low cost modes of transportation of vehicles to dealers were used, on average, to a moderate extent (a mean of 3.50). This result shows that small and frequent shipments were made between supply chain partners (flexibility) as well as the employment of a low cost transportation mode. Hence characteristics of both lean and agile supply chain strategies were exhibited.

- ***Information.*** Forecasting information is used to build master production schedules and create delivery dates for the production line or model to a very great extent (a mean of 4.58). However, demand was used to quickly transmit and reflect real demand accurately to a great extent (a mean of 3.92). The use of forecasting information indicates a lean supply chain strategy, while quick transmission of information on orders indicates an agile supply chain strategy.

- ***Supplier selection.*** Quality was used as a criterion for selecting suppliers to a great extent (a mean of 4.42). Low price/cost was also used as a criterion (a mean of 3.83). Dependability/sustainability was used to a great extent (a mean of 3.75) and flexibility to a moderate extent (a mean of 3.42). This result shows that supplier selection was based more on quality (which is a qualifier for both lean and agile supply chain) and cost which is a winner criterion for a lean supply chain strategy.

- ***Pricing strategy.*** Pricing strategy based on balancing supply chain demand tended to be implemented, to a moderate extent (mean of 3.4), based on low margins (low margins and high volume) to a moderate extent (a mean of 2.58) and differentiating products to a moderate extent (a mean of 2.83). The results show that balancing pricing and demand was the most implemented practice, followed by pricing based on low margins. Therefore, based on the pricing characteristics, manufacturers seemed to lean towards a lean supply chain strategy.

7.3.8 Responses regarding decision drivers of supply chain by manufacturer

The decision drivers of SCM were also analysed to understand how the different manufacturers used them. Mean level of agreement scores were used to present the results. The results are discussed in the same manner as in section 7.3.7 (production, inventory, location, transportation, information, supplier selection and pricing strategy). Table 7.27 presents the responses of the different manufacturers on decision drivers of supply chain. For the purpose of analysis, the following abbreviations were used: *E1* for European manufacturer 1; *E2* for European manufacturer 2; *E3* for European manufacturer 3; *AM* for American manufacturer; *A1* for Asian manufacturer 1; and *A2* for Asian manufacturer 2.

Table 7.27: Responses regarding decision drivers of the supply chain by manufacturers

Statements	Mean level of agreement					
	E1	AM	E2	A1	A2	E3
Production						
We have excess capacity in our production process	3.00	4.50	2.00	3.00	1.00	2.50
We have flexible manufacturing processes	2.00	3.50	4.00	2.75	2.00	3.00
Inventory						
We work on a strict JIT system and therefore keep inventory holding in the production process to a minimum	4.50	4.50	5.00	3.50	5.00	4.00
Location						
We have decentralised distribution centres (stores) to serve our dealers	3.00	4.50	2.00	2.25	1.00	3.00
Our local strategic suppliers are located close to our production plant	5.00	2.50	5.00	3.00	3.00	4.50
Transportation						
We make small and frequent shipments to our strategic customers	3.50	4.50	5.00	4.25	5.00	4.00
We receive small and frequent shipments from our strategic suppliers	4.00	4.00	4.00	3.50	5.00	4.00
We make use of the lowest acceptable mode of transportation for parts purchased from our strategic suppliers	4.50	4.50	3.00	3.75	3.00	3.50
We make use of the lowest acceptable mode of transportation for vehicles to our dealers	4.00	4.50	1.00	3.00	4.00	4.00
Information						
Information helps us to build master production schedules (forecasts) and create delivery dates	5.00	4.50	5.00	4.25	5.00	4.50
Information is used on actual demand to be transmitted quickly to reflect real demand accurately	5.00	3.00	5.00	3.75	2.00	4.50
Supplier selection						
We select suppliers on the basis of low price/cost	3.00	4.00	3.00	4.25	3.00	4.50
We select suppliers on the basis of high- quality standards	5.00	4.00	5.00	3.00	5.00	4.50
We select suppliers on the basis of dependability/sustainability	4.50	3.00	5.00	2.50	5.00	3.50
We select suppliers on the basis of flexibility	4.50	4.00	4.00	3.25	4.00	3.00
Pricing strategy						
Our pricing strategy is determined by balancing supply and demand	4.50	2.00	5.00	2.50	3.00	3.50
Our pricing strategy is based on low margins (low margins based on high volume)	4.00	1.00	3.00	3.25	2.00	3.00
Our pricing strategy is based on differentiation in the market	3.50	1.00	4.00	4.00	1.00	4.00

- ***Production.*** The American manufacturer had excess capacity in its production process to a very great extent (a mean of 4.50), while Asian manufacturer 2 had no excess capacity (a mean of 1.00). Flexible manufacturing was practised to a great extent by European manufacturer 2 (a mean of 4.00) and by the American manufacturer (a mean of 3.9), while European manufacturer 1 and Asian manufacturer 2 implemented the practice only to a slight extent (a mean of 2.00). This means that the American manufacturer seemed to lean towards an agile supply chain strategy, while Asian manufacturer 2 was inclined towards a lean supply chain.

- ***Inventory.*** European manufacturer 2 and Asian manufacturer 2 worked on a strict JIT system to a great and very great extent (means of 4.00 to 5.00) and Asian manufacturer 1 tended to implement the practice to a great extent (a mean of 3.50). This result is in line with the previous findings, where all the respondents (100%) indicated a lean supply chain strategy.

- ***Location.*** The American manufacturer used decentralised distribution centres (stores) to serve dealers to a very great extent (a mean of 4.50) and European manufacturers 1 and 3 to some extent (a mean of 3.00), while Asian manufacturer 1 mainly used centralised distribution systems (a mean of 1.00). European manufacturers 1, 2 and 3 had local strategic suppliers located close to the production plant to a very great extent (means of 4.50 to 5.00). European manufacturers 1 and 2 had their strategic suppliers close to the manufacturing plant to a very great extent (a mean of 5.00). Decentralised distribution and close suppliers are indicative of an agile supply chain strategy.

- ***Transportation.*** All the manufacturers, on average, made small and frequent shipments to their strategic customers and suppliers to a great or very great extent (means of 3.5 to 5.00). The result also indicates that European manufacturer 1 and the American manufacturer made use of low-cost transportation modes for parts purchased from strategic suppliers to a very great extent (a mean of 4.50). European manufacturers 1 and 3, the American manufacturer and Asian manufacturer 2 made use of the lowest acceptable mode of transportation for distributing vehicles to dealers, on average, to a great extent (means of 4.00 to 4.50), while European manufacturer 2 did not implement the practice at all (a mean of 1.00). This means that most of the manufacturers used low-cost and efficient means of transportation, which is a characteristic of a lean supply chain, while European manufacturer 2 used a flexible mode of transportation which is a characteristic of an agile supply chain.

- ***Information.*** All the manufacturers used forecasting information to build master production schedules and create delivery dates, on average, to a very great extent (a mean of 4.25 to 5.00). European manufacturers 1, 2 and 3 used information on actual demand that is transmitted quickly to accurately reflect real demand, on average, from a great extent to a very great extent (means of 4.00 to 5.00), while Asian manufacturer 2 implemented the practice to a slight extent (a mean of 2.00). Using forecasting information is indicative of a lean supply chain, while actual demand information indicates an agile supply chain. European manufacturers 1, 2 and 3 demonstrated both methods, which is indicative of a lean and agile (leagile) supply chain strategy.

- ***Supplier selection*** The American manufacturer, Asian manufacturer 1 and European manufacturer 3 used low price as a criterion to select their suppliers to a great extent (means of 4.00 to 4.50), while European manufacturers 1 and 2, and Asian manufacturer 2 used this criterion to a moderate extent (a mean of 3.00). All the manufacturers, except Asian manufacturer 1, used high-quality standards to select suppliers, on average, from a great to very great extent (means of 4.00 to 5.00). European manufacturers 1 and 2 selected suppliers on the basis of dependability and sustainability to a very great extent (means of 4.50 to 5.00). Four of the manufacturers (European manufacturers 1 and 2, Asian manufacturer 2 and the American manufacturer) used flexibility as the criterion to a great extent to select their suppliers (means of 4.00 to 4.50). Low cost as a criterion indicates a lean supply chain, while flexibility indicates an agile supply chain strategy.

- ***Pricing strategy.*** European manufacturers 1 and 2 used pricing strategy based on balancing supply and demand to a very great extent (mean values of 4.50 and 5.00 respectively). With regard to pricing strategy based on low margins, European manufacturer 1 recorded the highest mean value of 4.00 indicating a great extent, while the American manufacturer did not implement the strategy at all (a mean of 1.00). European manufacturers 1, 2 and 3 and Asian manufacturer 1 used differentiation to a great extent (means of 3.50 to 4.00). The American manufacturer and Asian manufacturer 2 did not use differentiation as a pricing strategy (a mean of 1.00). Balancing supply and demand and a low margin are typical pricing strategies of a lean supply chain and this was used by European manufacturers 1, 2 and 3. Differentiation is a typical pricing strategy for an agile supply chain and this was used by European manufacturers 1, 2 and 3 and Asian manufacturer 1.

7.3.9 Testing differences between manufacturers with different parent company origin regarding supply chain strategies

This subsection focuses on the differences between manufacturers based on the continent of origin of parent company and its impact on the application of supply chain strategies. The differences are discussed in relation to the product characteristics, manufacturing characteristics and the decision drivers of the supply chain. The Mann-Whitney U test was conducted to see whether there was a statistically significant difference between parent companies' origin (Asia and Europe) with regard to supply chain strategies.

The hypotheses tested for supply chain strategies were as follows:

H_0: Local manufacturers of light vehicles of Asian and European parent company origin do not differ statistically significantly with regard to their supply chain strategies in terms of product characteristics, manufacturing characteristics and decision drivers.
H_1: Local manufacturers of light vehicles of Asian and European origin differ statistically significantly with regard to their supply chain strategies in terms of product characteristics, manufacturing characteristics and decision drivers.

Table 7.28 reflects only the statements in which statistically significant differences, at the 5% level of significance, were found between the OEM parent companies' continent of origin with regard to their supply chain strategies. When comparing tables 7.19 with 7.21 and 7.26 with table 7.28, it is clear that companies of different origin did not differ statistically significantly with regard to most factors.

Table 7.28: Mann-Whitney test: statistically significant differences in supply chain strategies

Supply chain practices	**Mean rank**	**p-value**
Product characteristics		
The order lead time (order to delivery) takes more than three months	Asia = 7.20 Europe = 3.80	.045
Manufacturing characteristics		
We make provision in our manufacturing strategy for customers' demands (specifications)	Asia = 3.60 Europe = 7.40	.032
We change our manufacturing strategy quickly according to customer demands	Asia = 3.60 Europe = 7.40	.037
We manufacture on the basis of projected forecasts	Asia = 7.00 Europe = 400	.050
We have a pull system with specific customer orders	Asia = 3.40 Europe = 7.60	.021
Decision drivers		
Our local strategic suppliers are located close to our production plant	Asia = 3.60 Europe = 7.40	.033
Information is used on actual demand to be transmitted quickly to reflect real demand accurately	Asia = 3.70 Europe = 7.30	.043

Further analysis of the mean ranks indicates the following:

(1) The Asian manufacturers (mean rank = 7.20) tended to agree to a greater extent than the European manufacturers (mean rank = 3.80) that the order lead time takes more than three months.

(2) The European manufacturers (with a mean rank = 7.40) tended to agree to a greater extent that they made provision in their manufacturing strategy for customers' demands than the Asian manufacturers (with a mean rank = 3.60).

(3) European manufacturers (with a mean rank of 7.40) tended to agree to a greater extent that they could quickly change their strategy according to customer demands than the Asian manufacturers (with a mean rank = 3.60).

(4) The Asian manufacturers (mean rank = 7.00) tended to agree to a greater extent that they manufactured on the basis of the projected forecast than the European manufacturers (mean rank = 4.00).

(5) European manufacturers (mean rank = 7.60) tended to agree to a greater extent that they had a pull system with specific customers' orders than the Asian manufacturers (mean rank = 3.40).

With reference to the decision drivers the following results emerged:

(1) The European manufacturers (mean rank = 7.40) tended to agree to a greater extent that their local strategic suppliers were located close their production plants than the Asian manufacturers (mean rank = 3.60).

(2) The European manufacturers (mean rank = 7.30) tended to agree to a greater extent that they used information on actual demand to be transmitted quickly to reflect real demand accurately than the Asian manufacturers (mean rank = 3.70).

From the findings, it can be deduced that European originated manufacturers tended to follow an agile supply chain strategy, while Asian companies seemed to adopt a lean supply chain strategy.

7.3.10 Inbound and outbound supply chain strategies

In order to determine the supply chain strategies, respondents were asked to tick whether their strategy in the production line was a lean or agile supply chain for inbound and outbound directions. With reference to the inbound supply chain, all the respondents indicated that their strategy was based on efficiency (lean supply chain strategy). Table 7.29 indicates the responses of the respondents with reference to inbound supply chain.

Table 7.29: Responses regarding inbound supply chain strategy

Which of the following supply chain strategies for the product line are used for the inbound supply chain?	**Percentage**
Lean supply chain strategy (efficiency)	100.0%
Agile supply chain strategy (responsiveness)	0.0%

Regarding the outbound supply chain strategy for the production line, 66.7% of the respondents indicated that they followed a lean supply chain strategy, while 33.3% said they follow an agile supply chain strategy. Table 7.30 indicates the respondents' responses for the outbound supply chain strategy.

Table 7.30: Responses regarding outbound supply chain strategy

Which of the following supply chain strategies for the product line is used for the outbound supply chain?	**Percentage**
Lean supply chain strategy (efficiency)	66.7%
Agile supply chain strategy (responsiveness)	33.3%

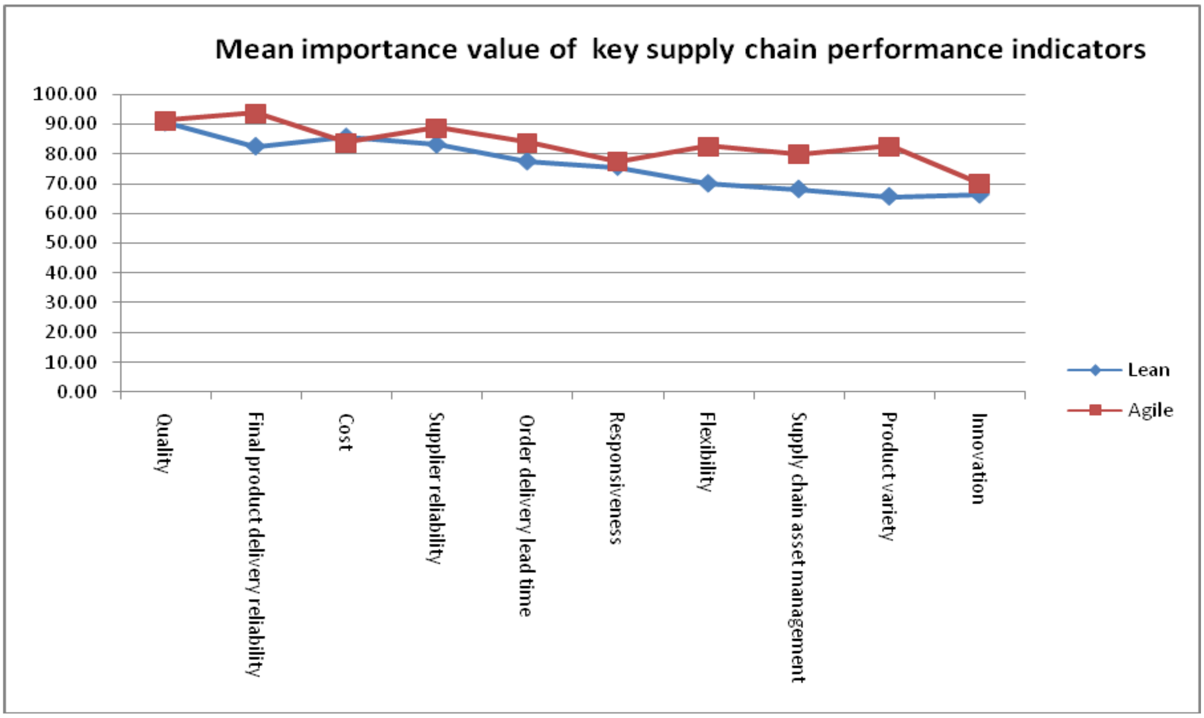
From tables 7.29 and 7.30 it is clear that a lean supply chain was the predominant supply chain strategy for light vehicle manufacturers of the models under investigation. However, few models employed an agile supply chain strategy in their outbound supply chain. These manufacturers therefore exhibited the leagile supply chain strategy and apply the practices of postponement (decision-making analysis). At that point, a lean supply chain in the inbound supply chain changes to an agile supply chain.

Logically, the chosen strategy should influence the importance of key performance indicators to some extent. In order to determine the influence of the supply chain strategy on the importance of the key supply chain indicators for the outbound supply chain, the means of the responses were calculated as shown in table 7.31 and graph 7.2 below.

Table 7.31: Key performance indicators and supply chain strategy (outbound supply chain)

	Lean	**Agile**
Quality	90.63	91.25
Final product delivery reliability	82.50	93.75
Cost	85.63	83.75
Supplier reliability	83.13	88.75
Order delivery lead time	77.50	83.75
Responsiveness	75.63	77.50
Flexibility	70.00	82.50
Supply chain asset management	68.13	80.00
Product variety	65.63	82.50
Innovation	66.25	70.00

Figure 7.2: Key performance indicators and supply chain strategy (outbound supply chain)



All indicators except cost had a higher importance average for the agile supply chain. This indicates that all the other indicators were crucial for optimising supply chain performance, irrespective of the type of supply chain strategy.

7.3.11 Summary of the results for supply chain strategies

This subsection summarises the results regarding supply chain strategies in terms of product characteristics, manufacturing characteristics, postponement and the decision drivers.

7.3.11.1 Product characteristics

The results of this study show that light vehicle manufacturers in the South African automotive industry did not only assemble pure standardised vehicles, but some were customised. Most of the vehicles had relatively stable demand and relatively accurate forecasting, indicating a functional product (associated with a lean supply chain strategy) (83.3% and 75.0% agreement respectively). The mean values for the European manufacturers (1, 2 and 3) indicated that the models were not standardised, but they were in fact customised models (associated with an agile supply chain strategy) (means of 1.00 to 2.50). Also, five of the six manufacturers disagreed that the order delivery lead time took more than three months (means of 1.50 to 2.00). While the result indicates that the European manufacturer 2 model was not a standard vehicle, the demand for the vehicle was stable (a mean of 4.00) - hence a mismatch in the product characteristics. The vehicles thus had both the characteristics of functional and innovative products, implying lean and agile (leagile) supply chain strategies.

7.3.11.2 Manufacturing characteristics

With reference to manufacturing characteristics, the result shows that the majority of vehicles were assembled on the basis of a low-cost manufacturing strategy for the production line (75.0% agreement). The majority of the manufacturers also kept minimum inventory in the production process (83.3% agreement) and manufacture, based on projected forecasting (100.0% agreement), thus indicating MTS (associated with a lean supply chain strategy). However, some of the manufacturers changed their strategy according to customer demands (41.7% agreement) and customised some parts in the production process to meet certain customers' order (50.0%), indicating MTO (associated with an agile supply chain strategy). Furthermore, a pull system was used by the majority of the respondents (66.7% agreement) which showed that to some extent, an MTO strategy was used, based on demands from dealers.

More than half of the respondents indicated that their manufacturing strategy for the production line was based on MTS (58.3%), while 41.7% indicated that models were based on MTO, indicating both lean and agile supply chain strategy. There were also some mismatches in the characteristics, because European manufacturer 3, for example, disagreed to having implemented a low-cost manufacturing strategy (a mean of 2.50), while minimum inventory was kept in the production process (a mean of 4.00). Asian manufacturer 2 was the only manufacturer who was more consistent regarding having implemented the practices in relation to lean supply chain strategy. While there were mismatches in the characteristics, it can be concluded that based on manufacturing characteristics, some of the vehicle manufacturers used an MTS strategy, for example, low manufacturing cost, keeping minimum inventory, while others used an MTO strategy such as changing manufacturing strategies according to customers' demand.

7.3.11.3 Postponement characteristics

With regard to postponement, the study revealed that all the respondents' strategic suppliers kept inventory in the form of modules, components and materials (100.0%). Also, fully assembled vehicles were kept in stock (83.3%) and with their dealers (100.0%). This shows that all the production lines at least employed a lean supply chain strategy. European manufacturers 1 and 2 kept work-in-progress inventory in stock to be customised for a particular customer (indicating the decision-making point or decoupling point) (means of 3.50 and 4.00 respectively). These manufacturers thus employed a lean and agile supply chain strategy (leagile supply chain strategy) while most of the manufacturers followed a lean supply chain. All the manufacturers except Asian manufacturer 1 (a mean of 2.75) on average indicated that modules, components and materials were only ordered when the customer specifications were known which means both lean and agile supply chain strategies were used. European manufacturer 1 did not make provision for finalisation of some features of the vehicle at the dealership, based on customer requests (a mean of 1.00), while European manufacturer 2 made provision for customisation (5.00). The results indicated that, based on the postponement characteristics, both lean and agile (leagile) supply chain strategies were used. However, there were mismatches in the practices.

7.3.11.4 Decision drivers of supply chain

The following is the summary of the results based on the decision drivers of SCM:

- ***Production.*** Excess capacity and flexible manufacturing processes were implemented, on average, to a moderate extent, indicating a tendency towards an agile and lean supply chain strategy (means of 2.91 to 2.92).
- ***Inventory.*** Working on a strict JIT system and keeping inventory holding in the production process to a minimum were implemented to a great extent, indicating a lean supply chain strategy (a mean of 4.17).
- ***Location.*** There were decentralised distribution centres (stores) to serve the dealers to a moderate extent indicating a tendency towards an agile supply chain (European manufacturers 1 and 3, and American manufacturer) as well as centralised distribution centres indicating a lean supply chain (European manufacturer 2, Asian manufacturers 1 and 2). Local strategic suppliers were located close to the production plant to a moderate extent, indicating a tendency towards an agile supply chain (a mean of 3.67).
- ***Transportation.*** Manufacturers made small and frequent shipments to their strategic customers to a great extent, indicating an agile supply chain (a mean of 4.25). Manufacturers received small and frequent shipments from strategic suppliers to a great extent, indicating, once again, a tendency towards an agile supply chain (a mean of 3.92). Manufacturers made use of a low-cost mode of transportation of

vehicles to dealers to a moderate extent, indicating a tendency towards a lean supply chain (a mean of 3.50).

- ***Information.*** Information was used to build master production schedules (forecasts) and create delivery dates for the model to a great extent, indicating a lean supply chain (a mean of 4.58). Information was used on actual demand to be transmitted quickly to reflect real demand accurately to a great extent (a mean of 3.92), thus indicating a tendency towards an agile supply chain.
- ***Supplier selection.*** Quality was the most used criterion for selecting suppliers (rated the highest), indicating the strategy could be lean or agile because quality is a qualifier for both strategies (a mean of 4.42 indicating a very great extent). The second highest rating for supplier selection was based on the use of low price/cost, indicating a tendency towards lean supply chain (a mean of 3.83 indicating to a great extent). Flexibility had the lowest mean rating (3.42 indicating to a moderate extent) thus indicating that agility was not a priority for the manufacturers.
- ***Pricing strategy.*** The highest mean value for pricing strategy was for balancing supply chain demand, indicating a lean supply chain criterion (a mean of 3.42 indicating to a moderate extent). A pricing model based on low margins (low margins based on high volume) was rated the lowest, indicating a slight inclination towards lean supply chain (a mean of 2.58 indicating to a moderate extent). A pricing strategy based on differentiation in the market was used to a moderate extent, indicating agile supply chain (a mean of 2.83).

7.4 CHAPTER SUMMARY

This chapter focused on the results and analysed and interpreted the results of the study. The discussion took place in two major sections. The first section dealt with the results pertaining to SCM best practices. This section focused on the extent to which supply chain best practices were implemented, based on inbound, outbound and internal. Also, the challenges impacting on South African automotive manufacturers and important key performance indicators of supply chain performance were discussed. In the second part of the analysis, supply chain strategies were analysed. The analysis was done in relation to product characteristics, manufacturing characteristics, postponement and the decision drivers of SCM. In both of the sections, the analysis was done for manufacturers overall and for specific manufacturers. Chapter 8 discusses the findings of the research, draws conclusions and makes recommendations.

CHAPTER 8

DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

8.1 INTRODUCTION

This chapter summarises the findings, draws conclusions and makes recommendations regarding the research into determining SCM practices and strategies in the South African automotive industry. The need for the study was based on the fact that the South African automotive industry operates in a highly competitive environment characterised by a growing demand from global customers. However, the industry is not internationally competitive and is being challenged by long order-to-delivery lead times and unreliable production schedules that lead to excess inventory throughout the value chain, lengthy demand planning cycles and lack of visibility to suppliers, material and production constraints causing scheduling delays and short-term production changes. There was the need to engage in a study to explore SCM practices and strategies in the South African automotive industry in order to suggest measures that the industry could employ to obtain a competitive advantage and adopt supply chain strategies that would be responsive to meeting customer demand and expectations.

8.2 REVISITING THE RESEARCH PROBLEM AND RESEARCH OBJECTIVES

As indicated in chapter 1, section 1.6, the statement of the problem was reflected in the main research question which was formulated as follows: Do local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies?

In an endeavour to answer the main research question, the following secondary questions were answered:

- To what extent are supply chain best practices implemented by local manufacturers of light vehicles in South Africa?
- What are the supply chain challenges faced by local manufacturers of light vehicles in South Africa?
- What are the most important key supply chain performance indicators that contribute to optimising the supply chain performance of local manufacturers of light vehicles in South Africa?

- What is the supply chain strategy of local manufacturers of light vehicles based on product line characteristics?
- What is the supply chain strategy of local manufacturers of light vehicles based on manufacturing characteristic?
- What is the supply chain strategy of local manufacturers of light vehicles based on the decision drivers of SCM?
- Is there a difference with reference to supply chain best practices and strategies between manufacturers of different parent company origin in South Africa?

The main aim of the study was *to determine whether local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies.*

The sub-objectives of the study were as follows:

- To determine the extent to which supply chain best practices are implemented by local manufacturers of light vehicles in South Africa
- To determine supply chain challenges faced by local manufacturers of light vehicles in South Africa
- To determine the key supply chain performance indicators most important in contributing to optimisation of the supply chain performance of local manufacturers of light vehicles in South Africa
- To determine supply chain strategies for locally manufactured light vehicles based on product line characteristics
- To determine supply chain strategies for locally manufactured light vehicles based on manufacturing characteristics
- To determine supply chain strategies for locally manufactured light vehicles based on decision drivers of SCM
- To determine in respect of supply chain practices and strategies, the differences between manufacturers of different continent origin (parent companies)
- To develop a conceptual framework for determining supply chain best practices in line with a chosen strategy that could guide supply chain managers (locally manufactured light vehicles) in the automotive industry in South Africa in their decision making

8.3 DISCUSSIONS OF THE RESULTS

This section of the chapter discusses the results. The discussion of this study is based on the results and interpretation as well as inferences made from the results in accordance with the research questions. To answer the main research questions, the secondary questions were answered first.

8.3.1 To what extent are supply chain best practices implemented by local manufacturers of light vehicles in South Africa?

In line with this question, supply chain best practices were examined in two ways. Firstly, the industry (across all manufacturers) was examined and, secondly, implementation by individual manufacturers was explored. The literature revealed that effective supply chain planning, built on shared information and trust between partners, is a vital part of successful supply chain functioning (ch 3, sec 3.4.4). The study identified supply chain best practices which include partnerships, establishing long-term relationships, cooperating with strategic suppliers and customers to improve processes, establishing trusting relationships, communicating with strategic partners to improve processes, sharing relevant information, goals and objectives and sharing supply chain risks. This study determined the extent to which these supply chain best practices are implemented. These practices form the basis of successful SCM implementation.

The results presented in chapter 7 revealed that across the supply chain, supply chain best practices were implemented to at least a great extent, except for sharing supply chain risk (implemented to a moderate extent). The most highly implemented practices were “building long-term relationships”, “cooperation to improve process” and “collaboration on new product development” (a mean of 4.25 to 4.58). “Sharing supply chain risk” was the least implemented across the inbound, outbound and internal supply chain (a mean of 3.17 to 3.75). In both inbound and outbound supply chain best practices, “building long-term relationships” was the most implemented practice (a mean of 4.58 and 4.33 respectively). “Cooperation to improve processes and operations” was among the top five most implemented practices of inbound supply chain (a mean of 4.42 and 4.50). However, it was actually the least implemented best practice with strategic customers (a mean of 3.67 to 3.83). This implies that there is still evidence of a silo mentality in practices on the customer side of the supply chain, and it is therefore clear that integration across the supply chain is not fully actualised. Across the supply chain, all the manufacturers perform better with their strategic suppliers compared with their strategic customers.

With reference to supply chain best practices by manufacturers, it can be concluded that European manufacturer 2 implemented supply chain best practices to a greater extent compared with the other manufacturers (overall mean of 4.58, from a great to a very great extent) across suppliers, customers and internal departments Asian manufacturer 1 indicated the lowest level of implementation of supply chain best practices (overall mean of 3.83, from a moderate to great extent) across the supply chain The least implemented best practice by all the manufacturers was sharing supply chain risk with strategic partners. Across the supply chain, all the manufacturers performed better with their strategic suppliers compared to their strategic customers.

8.3.2 What are the supply chain challenges faced by local manufacturers of light vehicles in South Africa?

It was established in the literature that the automotive industry is crucial to the South African economy, but it faces enormous challenges in the supply chain. The results revealed that all the respondents who agreed that there are challenges (more than 50% agreement) also concurred that the challenges were at least moderately difficult to fix (at least 50%). Table 8.1 indicates the challenges facing the South African automotive supply chain (only with more than 50% agreement) and the percentages for rectifying these difficulties.

Table 8.1: Challenges facing light vehicle manufacturers in South Africa and the problems involved in overcoming these challenges

Challenges	(%) of agreement	% difficulty to fix
Technological challenges		
We incur high costs when replacing obsolete assembly/manufacturing tools	83.3%	83.3%
Infrastructural challenges		
Increased road freight volumes	66.7%	50.0%
We are challenged by delays at ports	91.7%	83.4%
Cost challenges		
High fuel costs affect our operating costs	100.0%	100.0%
We have high operating costs	75.0%	75.0%
We incur high costs at South African ports	91.7%	91.7%
The prices of materials/components are high	66.7%	66.7%
Market/service challenges		
It is difficult finding new markets	58.4%	58.4%
Sometimes our customers cancel their orders	75.0%	66.7%
We are challenged to improve our service levels	66.7%	58.3%
Production/skills challenges		
We are challenged by lack of skills	58.4%	58.3%
We are challenged by labour problems	66.7%	50.0%

As discussed in chapter 7, section 7.2.6, where more than 50% of the respondents agreed on a particular challenge, at least 50% of the respondents indicated that the complexity of overcoming the challenge was at least moderately difficult. Light vehicle manufacturers should first focus on those challenges that would be easy to overcome because they require less effort. Most of the main problems mentioned in table 7.18 such as road freight volumes, delays at ports, unreliability of rail, high fuel costs, high operating costs, high costs at ports and, high prices of materials are difficult to fix and are beyond the control of the manufacturers. However, a few of the challenges that are difficult to overcome are actually avenues for the manufacturers to focus their efforts for becoming more competitive, such as replacing obsolete assembly/manufacturing tools and finding new markets. Cancellation of customer orders and improving service level would be relatively easier to resolve and could be a starting point for improvement.

8.3.3 What are the most important key supply chain performance indicators that contribute to optimising the supply chain performance of local manufacturers of light vehicles in South Africa?

In this study, ten performance indicators were identified and the respondents were asked to rate, with a score between 0 and 100, how important the indicator's contribution is to the optimisation of supply chain performance. The results revealed that, overall, quality was considered the most important performance indicator, followed by final product delivery reliability and then cost and supplier reliability in optimising automotive industry supply chain performance. Innovation and product variety were rated the lowest. With reference to the most important performance indicator by individual manufacturer, European manufacturers 1 and 2 indicated the highest ratings (means of 91.5 and 86.5) for all the performance indicators towards contributing to optimisation of supply chain performance. European manufacturers 1 and 2 also indicated the highest mean rating for order delivery lead time, responsiveness and flexibility, indicating that they followed agile supply chain strategies. The lowest mean rating was recorded by the American manufacturer for order delivery lead time and product variety, which means that its focus was on lean supply chain.

This result also shows that quality is not a negotiable issue in the automotive industry and is a key requirement for vehicle manufacturers. This is in line with other research findings. Automotive manufacturers are paying more attention to quality issues which reduces the number of defects in vehicles. Furthermore, there is no significant difference in quality between vehicles from Asia, America and Europe. The result thus shows that all the indicators are crucial for optimisation of the supply chain performance of European manufacturers compared with Asian and American manufacturers. This indicates that European manufacturers pose some important characteristics of a responsive supply chain (agile).

8.3.4 What is the supply chain strategy of local manufacturers of light vehicles based on product line characteristics?

Many aspects of a product are significant in determining a supply chain strategy, for example, types of product, demand predictability and market standards for lead times and service. Based on these characteristics, products can be categorised as either primarily functional or primarily innovative. Functional products employ a lean supply chain strategy, while innovative products follow an agile supply chain strategy (as discussed in the literature study).

This result of the study shows that light vehicle manufacturers in the South African automotive industry do not only assemble pure standardised vehicles, but some are customised. Most of the vehicles have relatively stable demand as well as relatively accurate forecasting for the model, indicating a functional product (associated with lean supply chain strategy) (83.3% and 75.0% agreement respectively). The mean values for the European manufacturers (1, 2 and 3) indicated that their models were not a standard vehicle (model), but in fact customised models (associated with an agile supply chain strategy) (means of 1.00 to 2.50). Also all the manufacturers, except Asian manufacturer 1, disagreed that the order delivery lead time takes more than three months (means of 1.50 to 2.00). While the result indicates that the European manufacturer 2 model was not a standard vehicle, the demand for the vehicle was stable (a mean of 4.00) - hence there was a mismatch in the product characteristics. The vehicles had both the characteristics of functional and innovative products, implying they should practise lean and agile supply chain strategies.

Owing to the fact that functional products follow a lean supply chain while innovative products follow an agile supply chain, there is a need to determine exactly which model (production line) followed what strategy. A portfolio matrix was developed to determine the mismatch between the product and the strategy. Characteristics of product types and market demand among the characteristics discussed in chapter 7 (sec 7.3.1) were matched against each other. Only these two characteristics could be used because more than two characteristics could not be used in the matrix. Also the characteristics are vital in determining a product type. Table 8.2 indicates the alignment between the selected product characteristics and supply chain strategies. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 8.2: Aligning product characteristics and supply chain strategy

Light vehicle	Key product characteristics	Mean	Type of product based on characteristics	Supply chain strategy based on product type
E1	Model is standard	1.00	Innovative	Agile supply chain
	Demand is stable	2.50	Innovative	Agile supply chain
AM	Model is standard	4.50	Functional	Lean supply chain
	Demand is stable	4.50	Functional	Lean supply chain
E2	Model is standard	2.00	Innovative	Agile supply chain
	Demand is stable	4.00	Functional	Lean supply chain
A1	Model is standard	3.25	Functional	Lean supply chain
	Demand is stable	4.00	Functional	Lean supply chain
A2	Model is standard	4.00	Functional	Lean supply chain
	Demand is stable	4.00	Functional	Lean supply chain
E3	Model is standard	2.50	Innovative	Lean supply chain
	Demand is stable	3.00	Functional	Agile supply chain

As indicated table 8.2, the mean value was used against the demand characteristics to reflect the type of product (functional and innovative products). As discussed earlier, a functional product follows a lean supply chain and an innovative (customised) product an agile supply chain. Figure 8.1 provides a portfolio matrix for aligning product characteristics and supply chain strategy.

Figure 8.1: Portfolio matrix for product characteristics

	Functional product	Innovative product
Stable demand	**MATCH (LEAN SUPPLY CHAIN) Asian manufacturers 1 and 2; American manufacturer**	**MISMATCH European manufacturers 2 and 3**
Volatile demand	**MISMATCH**	**MATCH (AGILE SUPPLY CHAIN) European manufacturer 1**

As indicated in table 8.2, there was a mismatch in the relationship between product characteristics and supply chain strategies. From the portfolio matrix (figure 8.1) Asian manufacturers 1 and 2, the American manufacturer and European manufacturer 1 were correctly positioned (match). European manufacturers 2 and 3 were wrongly positioned (mismatch), because they indicated that their vehicle was an innovative (customised) product, but the demand is stable.

8.3.5 What is the supply chain strategy of local manufacturers of light vehicles based on manufacturing characteristics?

The nature of manufacturing characteristics determines a supply chain strategy. As established in the literature, two prominent manufacturing characteristics are make-to-stock (MTS) and make-to-order (MTO). The characteristics were analysed in relation to the strategies. MTS generally follows a lean supply chain, while MTO, taking demands from the final customer into account, follows an agile supply chain. The results of the study show that the majority of vehicles were assembled based on a low-cost manufacturing strategy for the production line (75.0% agreement). The manufacturers also kept minimum inventory in the production process (83.3% agreement) and manufacture based on projected forecasting (100.0% agreement) indicating MTS (associated with a lean supply chain strategy). However, some of the manufacturers changed their strategy according to customer demands (41.7% agreement) and customised some parts in the production process to meet certain customers' orders (50.0%), indicating MTO (associated with an agile supply chain strategy). Furthermore, a pull system was used by the majority of the respondents (66.7% agreement), which shows that to some extent, the MTO strategy was used, based on the demands from dealers.

More than half of the respondents indicated that their manufacturing strategy for the production line was based on MTS (58.3%), while 41.7% indicated that the models were based on MTO, indicating that both lean and agile supply chain should be employed. There were also some mismatches in the characteristics as European manufacturer 3, for example, disagreed to having implemented a low-cost manufacturing strategy (a mean of 2.50), while minimum inventory was kept in the production process (a mean of 4.00). Asian manufacturer 2 was the only manufacturer that was more consistent in implementing the practices in relation to a lean supply chain strategy. While there were mismatches in the characteristics, it can be concluded that on the basis of the manufacturing characteristics, some of the vehicle manufacturers executed a MTS strategy, for example, low manufacturing cost, keeping minimum inventory, while others adopted an MTO strategy such as changing manufacturing strategies according to customers' demands.

A portfolio matrix was also developed from the results in order to establish how the manufacturing strategies were aligned with supply chain strategies for each particular model (production line). Only two characteristics, *low-cost manufacturing strategy* and *keeping inventory to a minimum in the production process* were used because more than two characteristics could not be used on the matrix. They were also key differentiation characteristics. Table 8.3 shows the alignment of supply chain strategy based on manufacturing characteristics. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 8.3: Aligning manufacturing characteristics and supply chain strategy

Light Vehicle	Manufacturing characteristics	Mean	Strategy based manufacturing characteristics	Supply chain strategy based on MTS and MTO strategy
E1	Low-cost manufacturing strategy	3.00	MTS	Leagile supply chain
	Keep minimum inventory in production	3.50	MTS	Lean supply chain
AM	Low-cost manufacturing strategy	5.00	MTS	Lean supply chain
	Keep minimum inventory in production	4.50	MTS	Lean supply chain
E2	Low-cost manufacturing strategy	4.00	MTS	Lean supply chain
	Keep minimum inventory in production	4.00	MTS	Lean supply chain
A1	Low-cost manufacturing strategy	4.50	MTS	Lean supply chain
	Keep minimum inventory in production	4.50	MTS	Lean supply chain
A2	Low-cost manufacturing strategy	4.00	MTS	Lean supply chain
	Keep minimum inventory in production	5.00	MTS	Lean supply chain
E3	Low-cost manufacturing strategy	2.50	MTO	Agile supply chain
	Keep minimum inventory in production	4.00	MTS	Lean supply chain

The information in table 8.3 was used to develop a portfolio matrix. The objective was to determine whether the manufacturing practices were performed in relation to their supply chain strategy. The mean scores for the manufacturers were matched against the manufacturing characteristics to determine whether the model actually followed was MTS (associated with lean supply chain) or MTO (associated with an agile supply chain). Figure 8.2 provides a portfolio matrix for manufacturing characteristics.

Figure 8.2: Portfolio matrix for manufacturing characteristics

	Low-cost strategy	Differentiated strategy
Minimum inventory	**MATCH (LEAN SUPPLY CHAIN) European manufacturers 1 and 2; Asian manufacturers 1 and 2; American manufacturer**	**MISMATCH European manufacturer 3**
Hold inventory	**MISMATCH**	**MATCH (AGILE SUPPLY CHAIN)**

As indicated in figure 8.2, based on the manufacturing characteristics, all the manufacturers were correctly positioned except for European manufacturer 3, which was wrongly positioned (mismatch). The manufacturer should not keep inventory to a minimum and at the same time, engage in high-cost/differentiated supply chain. Hence there was a mismatch in the relationship at one manufacturer, based on those two characteristics.

From the discussion of the product and manufacturing characteristics, it is evident that both lean and agile supply chain strategies should be applicable to light vehicle manufacturers in South Africa. However, to determine the exact positions (side of the supply chain) of lean and agile (or leagile) supply chain strategies, the concept of postponement needs to be employed. In the leagile supply chain paradigm (ch 4, sec 4.5.6), lean and agile are combined within a total supply chain strategy by positioning the decoupling point (DP) in order to best suit the need for responding to a volatile demand downstream, but providing level scheduling upstream from the DP. Postponement is used to move the DP closer to the end user and increase efficiency and effectiveness of the supply chain. To determine the supply chain strategy on the different sides of the supply chain for each of the models (production lines), the study also sought responses on questions relating to postponement. Four forms of postponements are full postponement (CTO), manufacturing postponement (MTO) and assembly postponement (ETO), which are all associated with agile supply chain strategy; and full speculation (MTS), which is associated with lean supply chain strategy.

The results relating to postponement revealed that, for all manufacturers, their strategic suppliers kept inventory in the form of modules, components and materials (100.0%). Also, fully assembled vehicles were kept in stock by the majority (83.3%) and with their dealers by all respondents (100.0%). This shows that all the production lines engaged in full speculation based on projected forecasting and therefore at least employed a lean supply chain strategy. European manufacturer 1 and 2 agreed that they kept work-in-progress inventory in stock to be customised for a particular customer (indicating the decision making point or decoupling point) (means of 3.50 and 4.00 respectively). These manufacturers thus employed a lean and agile supply chain strategy (leagile supply chain strategy), while most of the manufacturers followed a lean supply chain strategy. All the manufacturers except Asian manufacturer 1 and the American manufacturer (means of 2.75 and 3.00) on average, agreed that modules, components and materials were only ordered when the customer specifications were known, which means both lean and agile supply chain should be employed. European manufacturer 1 did not add some features of the vehicle at the dealership, based on customer request (a mean of 1.00), while European manufacturer 2 did (5.00). The results indicate that, based on the postponement characteristics, both lean and agile (leagile) supply chain strategies should be implemented.

To determine the position in the supply chain where inventory is held (postponement exists) for each of the models, two characteristics, namely holding *WIP inventory* (MTO), and adding *some features at the dealership, based on customer requests,,* were used, as they depict different postponement points in the supply chain.   Table 8.4 presents an alignment of postponement characteristics to supply chain strategies. For purposes of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 8.4: Aligning types of postponement to supply chain strategy

Light Vehicle	Postponement characteristics	Mean	Forms of postponement based on manufacturing characteristics	Supply chain strategy based on forms of postponement
E1	WIP is kept to be customised for specific orders	3.50	Manufacturing postponement	Agile supply chain
	Some features are added to the vehicle at the dealership based on the final customer request	1.00	Full speculation	Lean supply chain
AM	WIP is kept to be customised for specific orders	1.50	Full speculation	Lean supply chain
	Some features are added to the vehicle at the dealership based on the final customer request	3.00	Full speculation	Lean supply chain
E2	WIP is kept to be customised for specific orders	4.00	Manufacturing postponement	Agile supply chain
	Some features are added to the vehicle at the dealership based on the final customer request	5.00	Full speculation	Lean supply chain
A1	WIP is kept to be customised for specific orders	2.75	Full speculation	Lean supply chain
	Some features are added to the vehicle at the dealership based on final customer request	4.25	Full speculation	Lean supply chain
A2	WIP is kept to be customised for specific orders	1.00	Full speculation	Lean supply chain
	Some features are added to the vehicle at the dealership based on the final customer request	5.00	Full speculation	Lean supply chain
E3	WIP is kept to be customised for specific orders	2.00	Full speculation	Lean supply chain
	Some features are added to the vehicle at the dealership based on the final customer request	3.00	Full speculation	Lean supply chain

As indicated in table 8.4, the form of postponement for each model was determined from the characteristics and their mean scores. Thereafter, the supply chain strategy was known based on the forms of postponement. It is clear from table 8.4 that most of the models had the full speculative form of postponement, indicating a lean supply chain strategy, while European manufacturers 1 and 2 had manufacturing postponement, indicating a leagile supply chain strategy. To further determine whether their responses were in line with practices, a portfolio matrix was developed. Figure 8.3 provides the portfolio matrix on postponement.

Figure 8.3: Portfolio matrix for postponement

Hold WIP to be customised for specific customer request	**MATCH** **(AGILE SUPPLY CHAIN)** **European manufacturer 1**	**MISMATCH** **European manufacturer 2**
Do not hold WIP inventory	**MISMATCH**	**MATCH** **(LEAN SUPPLY CHAIN)** **Asian manufacturers 1 and 2;** **American manufacturer;** **European manufacturer 3**
	No provision made for features to be added at dealership based on customer request	Provision made for features to be added at dealership based on customer request

If WIP inventory has been customised at manufacturing, there is little or no chance of features being added to the model because it was done based on customer request. As indicated in figure 8.3, all the manufacturers were correctly positioned except for European manufacturer 2, which indicates that they kept WIP inventory to be customised for specific customer needs and some features were also added at the dealership, based on customers' requests.

8.3.6 What is the supply chain strategy of local manufacturers of light vehicles based on the decision drivers of SCM?

Decision drivers are the guiding pillars of SCM decisions. The decision drivers examined in the study were production (facilities), inventory, location, transportation, information, supplier selection and pricing. How these drivers are implemented determines whether the supply chain employs a lean supply chain or an agile supply chain or a combination of the two (leagile supply chain). The results across the industry are summarised below.

Excess capacity exists and flexible manufacturing processes are implemented, on average to a moderate extent. Working on a strict JIT system and keeping inventory holding in the production process to a minimum are implemented to a great extent, indicating a lean supply chain. These findings are consistent with a lean supply chain. In addition, decentralised distribution centres (stores) serving dealers were implemented to a moderate extent, also indicating a lean supply chain. Finding local strategic suppliers located close to the production plant occurs a great extent, which is consistent with an agile supply chain.

Manufacturers make small and frequent shipments to their strategic partners to a great extent, indicating an agile supply chain. Manufacturers make use of low-cost modes of transportation, indicating a lean supply chain. Information used to build master production schedule (forecasts) with fixed delivery dates is implemented to a very great extent, indicating a lean supply chain. European manufacturers 1 and 2 were the manufacturers with the highest mean ratings (to a very great extent) for using information on actual demand to be transmitted quickly to reflect real demand, thus accurately indicating an agile supply chain. Asian manufacturer 2 indicated that information on actual demand is used to a slight extent, indicating a lean supply chain.

The American manufacturer, Asian manufacturer 1 and European manufacturer 3 selected their suppliers on the basis of price/quality to a great extent, indicating a lean supply chain. European manufacturers 1, 2 and 3 selected suppliers accordingly to quality standards to a very great extent (could be lean or agile). European manufacturer 2 and Asian manufacturer 2 selected suppliers on the basis of dependability and sustainability to a very great extent, indicating a lean supply chain. All the manufacturers considered selecting suppliers on the basis of flexibility, from a moderate extent to a very great extent.

The results reveal that both lean and agile supply chain practices are evident in the South African automotive industry. Table 8.5 represents an alignment of the decision drivers and supply chain strategies by the manufacturers. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 8.5: Aligning decision drivers to supply chain strategies

Drivers	Lean supply chain	Agile supply chain
Production	Little excess capacity (E2 and E3; A2)	Excess capacity (E1; AM and A1)
Inventory	Work on a strict JIT system (E1, E2 and E3, AM, A1 and A2)	
Location	Centralised distribution centres (A1 and 2; E2)	Decentralised distribution centres (E1 and E3; AM)
Transportation	Low-cost mode of transport to dealers (E1 and E3; AM, A1 and A2)	Fast and flexible shipments to dealers (E2)
Source of information	Builds master production schedule and creates fixed delivery dates (E1, E2 and E3; AM; A1 and A2)	Transmits actual demand to reflect accurate demand (E1, E2 and E3)
Supplier selection	Based on quality, cost (E1, E2 and E3; AM; A1 and A2)	Based on quality, flexibility (E1, E2 and E3; AM; A1 and A2)
Pricing	Based on low margins (E1, E2 and E3; A1)	Based on differentiation (AM and A2)

Table 8.5 shows some degree of mismatch between the drivers of supply chain and supply chain strategies among the vehicles. In both the portfolio matrixes, Asian manufacturer 1, for example, was placed as a lean supply chain, but in table 8.5, it has an excess capacity in the production process, which is in fact an agile supply chain characteristic. European manufacturer 3 was a mismatch in the product matrix, manufacturing matrix and also in the decision drivers. This means they are trying to be both lean and agile without executing the trade-off practices of lean and agile supply chain, as suggested by the literature. All manufacturers (European manufacturers 1, 2 and 3; American manufacturer; Asian manufacturers 1 and 2) utilised quality, cost and flexibility criteria for selecting suppliers, which involve both lean (cost) and agile (flexibility) characteristics. In conclusion, some practices employed by the local manufacturers are inconsistent with their strategies.

8.3.7 Regarding supply chain best practices and strategies, is there a difference between manufacturers of different parent company origin in South Africa?

To answer this sub-research question, hypotheses were formulated about parent company origin differences with regard to supply chain practices and strategies of light vehicle manufacturers of different origin:

Hypothesis 1 was formulated as follows:

H_0: Local manufacturers of light vehicles of Asian and European origin do not differ statistically significantly with regard to their supply chain best practices.

H_1: Local manufacturers of Asian and European origin differ statistically significantly with regard to their supply chain best practices.

Overall, the European manufacturers in the South African automotive industry implemented supply chain best practices to a greater extent than the Asian manufacturers.

For inbound supply chain best practices:

- Local European origin manufacturers differ statistically significantly from the Asian origin manufacturers in implementing long-term relationships with their strategic suppliers.
- The local European origin manufacturers also differ statistically significantly from the Asian manufacturers on cooperation with their strategic suppliers to improve processes.
- Lastly, the European manufacturers differ statistically significantly from the Asian manufacturers on having a trusting relationship with their strategic suppliers.

For outbound supply chain best practices:

- Local manufacturers of European origin differ statistically significantly from Asian manufacturers with regard to sharing supply chain risks with their strategic suppliers.

For internal supply chain best practices:

- Manufacturers of European origin differ statistically significantly from the Asian manufacturers with regard to sharing relevant information with other departments.

Hypothesis 2 was formulated as follows:

H_0: Local manufacturers of light vehicles of Asian and European origin do not differ statistically significantly with regard to the way they perceive supply chain challenges.
H_1: Local manufacturers of Asian and European origin differ statistically significantly with regard to the way they perceive supply chain challenges.

The alternative hypothesis was proven to be correct, as indicated below:

- The Asian manufacturers differ statistically significantly from with the European manufacturers in that that they have inadequate information systems (they therefore feel more positive about the adequacy of their information system than European manufacturers).
- The European manufacturers differ statistically significantly from the Asian manufacturers regarding the unreliability of rail transport.
- The European manufacturers differ statistically significantly from their Asian counterparts regarding their being more challenged by labour problems.

Hypothesis 3 was formulated as follows:

H_0: Local manufacturers of light vehicles of Asian and European origins do not differ statistically significantly with regard to their supply chain performance indicators.
H_1: Local manufacturers of Asian and European origins differ statistically significantly with regard to their supply chain performance indicators.

The alternative hypothesis was proven to be correct, as indicated below:

- Final product delivery reliability was statistically significantly more important in contributing to optimising supply chain performance in European manufacturers than in Asian manufacturers.
- Order delivery lead time was statistically significantly more important to optimising supply chain performance for European manufactures than Asian manufacturers.

Hypothesis 4 was formulated as follows:

H_0: Local manufacturers of light vehicles of Asian and European origin do not differ statistically significantly with regard to their supply chain strategies in terms of product characteristics, manufacturing characteristics and decision drivers.

H_1: Local manufacturers of Asian and European origin differ statistically significantly with regard to their supply chain strategies in terms of product characteristics, manufacturing characteristics and decision drivers.

The alternative hypothesis was proven to be correct, as indicated below:

- The Asian manufacturers indicated order lead times of more than three months, which differ statistically significantly from the European manufacturers.
- The European manufacturers differ statistically significantly in that they make greater provision in their manufacturing strategy for customers' demand than the Asian manufacturers.
- The European manufacturers differ statistically significantly in that they can quickly change their strategy according to customer demands compared to the Asian manufacturers.
- The Asian manufacturers differ statistically significantly in that they manufacture on the basis of the projected forecast compared to the European manufacturers.
- The European manufacturers differ statistically significantly in that they have a pull system with specific customers' orders compared to the Asian manufacturers.
- The European manufacturers differ statistically significantly in that their local strategic suppliers are located closer to their production plants than the Asian manufacturers' suppliers.
- The European manufacturers differ statistically significantly in that they use information on actual demand to be transmitted quickly to reflect real demand accurately compared to the Asian manufacturers.

8.3.8 Main research question: Do local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies?

From the results of the secondary research questions, the light vehicle manufacturers employ lean and agile supply chain strategies which are generic supply chain strategies. However, there are mismatches in the supply chain strategies and practices employed. The portfolio matrix for product shows that European manufacturers 2 and 3 indicated having a stable demand, but the product type was innovative. In the manufacturing matrix, European manufacturer 3 indicated that it uses a low-cost manufacturing strategy but maintains minimum inventory in the product process, which indicates a mismatch. That notwithstanding, the study shows that some manufacturers employed good supply chain strategies for the product to a moderate extent.

In the product matrix, Asian manufacturers 1 and 2 and the American manufacturer exhibited characteristics consistent with lean supply chain, while European manufacturer 1 portrayed agile supply chain characteristics, and European manufacturers 2 and 3 were placed in the wrong position (mismatch). In the manufacturing matrix, European manufacturers1 and 2, the American manufacturer and Asian manufacturers 1 and 2 employed a lean supply chain strategy, and European manufacturer 3 was wrongly placed (mismatch). European manufacturer 1 employed a lean supply chain, thus indicating a leagile supply chain strategy. Regarding postponement, only European manufacturers 1 and 2 kept work in progress inventory, indicating a decision-making point at the manufacturer. This indicates that both production lines employ leagile supply chain strategies. Finally, with reference to the alignment of the decision drivers and supply chain strategies, there were mismatches with reference to European manufacturer 3 and Asian manufacturer 1 and the American manufacturer.

Given that only European manufacturers 1 and 2 held inventory in the production process, as well as the characteristics of the decision drivers, they tend to follow a leagile supply chain. In addition, based on the characteristics portrayed by the other manufacturers (European manufacturer 3, Asian manufacturer 1 and 3 and the American manufacturer), this study can conclude that the production lines are based more on lean supply chain strategy.

Reviewing the respondents' views on the supply chain strategy in the production line shows that all the respondents noted that the inbound supply chain strategy for all the models was a lean supply chain (100%), while in the outbound, more than half of the manufacturers (66.7%), stated that the supply chain strategy was lean. Only one-third (33.3%) indicated that the outbound supply chain was agile. Relating this view to the findings of this study further indicates a mismatch between what the respondents thought and what the strategy actually is. Table 8.6 represents the supply chain strategies employed according to this study and the respondents' views on strategy for the production line, based on product type and manufacturing techniques. For the purpose of analysis, the following abbreviations were used: E1 for European manufacturer 1; E2 for European manufacturer 2; E3 for European manufacturer 3; AM for American manufacturer; A1 for Asian manufacturer 1; and A2 for Asian manufacturer 2.

Table 8.6: Supply chain strategies for the models according to manufacturers

Manufacturer	Supply chain strategy (respondents)	Supply chain strategy (findings)
E1	Leagile supply chain	Leagile supply chain
AM	Lean supply chain	Lean supply chain
E2	Lean supply chain	Leagile supply chain (mismatch exists)
A1	Leagile supply chain	Lean supply chain (mismatch exists)
A2	Lean supply chain	Lean supply chain
E3	Lean supply chain	Agile supply chain (mismatch exists)

Hence local manufacturers of light vehicles in the South African automotive industry employ optimal supply chain strategies to a moderate extent. A mismatch may indicate that the practices and strategies which a manufacturer employs are not in line with the strategy they are supposed to implement, based on the characteristics of the product, manufacturing techniques and decision drivers. Mismatch leads to incorrect decisions in the supply chain and this generally gives rise to poor supply chain performance.

8.4 CONCLUSIONS AND RECOMMENDATIONS

8.4.1 Summary of the research study

This section of the chapter provides a summary of the study. The purpose of the study was to "determine whether local manufacturers of light vehicles in South Africa use supply chain best practices and strategies". The automotive industry was chosen for the study because of its strategic contribution to the South African economy, and many other studies have shown that the industry faces great supply chain challenges. The rationale for and focus of the study differed from those of other studies. This study focused on supply chain strategies as a possible challenge for automotive manufacturers. Light vehicle manufacturers were the focus in the study, with the aim of exploring the total sample population. The study began by providing background information, the problem statement, research objectives and questions and justification for the study in chapter 1.

In chapter 2, the theoretical framework for SCM was discussed. This involved defining and giving the background to SCM and explaining the key supply chain integration practices, relationships in the supply chain, processes and key decision areas in the supply chain. The chapter contributed to understanding the concept and practices of SCM towards determining the optimal supply chain strategies and practices employed by local manufacturers of light vehicles in the South African automotive industry.

In chapter 3, SCM practices in the automotive industry were discussed. The chapter focused on the global and South African automotive industry, automotive supply chain practices and challenges in South Africa. It was revealed that the automotive industry is driven by competitiveness and innovation that compels industry manufacturers and their suppliers to continuously adapt to changes in the marketplace. In South Africa, the industry is leading in the implementation of SCM and is a major contributor to GDP and the creation of employment. However, the industry faces supply chain challenges that influence effectiveness and efficiency, which hinders the industry from becoming a significant player in the global industry – hence the need to conduct a study to explore supply chain strategies that would meet the changing needs of customers.

Chapter 4 focused on SCM strategies, and different types of strategies and their characteristics. The chapter established the criteria for understanding the different types of strategies and the various combinations of strategies. It was further noted that because supply chains have moved from a cost focus, to a customer focus, to a strategic focus, there is a crucial need to think strategically about the supply chain. An appropriate supply chain strategy, linked to operational excellence, can provide success for not only the company in question, but also its partners in the supply chain. Customers are more informed and have greater expectations about reduced lead time, just-in-time delivery and value-added services. They expect greater responsiveness and reliability from their suppliers. However, supply chain managers of the manufacturers are pressured for low costs in order to remain competitiveness.

In chapter 5, the instrument for determining supply chain strategies was developed. It was posited that a supply chain strategy determines the practices in the supply chain and that a strategy in the supply chain should be determined by particular circumstances. The chapter revealed the different characteristics and attributes of lean and agile supply chain strategies. Furthermore, it suggested a framework for implementing appropriate supply chain strategies. These strategies are lean (efficient), agile (responsive) and a combination of the two (leagile) supply chain strategies. Three key determinants of supply chain strategies were identified, namely product characteristics, manufacturing characteristics and decision drivers.

Chapter 6 presented the research design and methodology for the study. Research design and methodology guide a researcher in planning and implementing a study in a way that is most likely to achieve the intended outcome. Chapter 3 provided the blueprint for conducting the research and explained the careful choice of the research design, demarcation of the population, the specific sampling procedure, data collection and procedures for measurement of the research instrument, testing the research instrument and the method of data analysis employed in the study. The research design used in the study was a combination of exploratory and descriptive research design, using qualitative and quantitative approaches based on a survey of light vehicle manufacturers in the South African automotive industry. A face–to-face, semi-structured interview questionnaire was used based on the purposive sampling technique. Data analysis and interpretation were based on descriptive statistics using SPSS software.

In chapter 7, the primary focus was to present, analyse and interpret the research data in line with the purpose and objectives of the study. The presentation, analysis and interpretation of the results were discussed in different sections on the basis of the questions posed in the interview questionnaire. The questionnaire was semi-structured and comprised two major sections. Section A dealt with SCM practices and section B, SCM strategies. Section A consisted of five categories of questions, while section B consisted of seven categories. The findings of the study were presented and analysed using tables, figures and graphs. In some instances, preliminary deductions were made.

In this chapter (8), the results were discussed and conclusions drawn from the main research objective.

8.4.2 Conclusions relating to the research objectives

Regarding the main objective of the study, the secondary objectives and their contribution to the main objective are briefly discussed below.

- *To determine the extent to which supply chain best practices are implemented by local manufacturers of light vehicles in South Africa*

The findings of the study show that all manufacturers implemented supply chain best practices to at least a great extent. Sharing supply chain risks had the lowest rating across the inbound, outbound and internal supply chain. In both the inbound and outbound supply chain practices, building long-term relationships was the most implemented practice, while sharing supply chain risk was the least implemented. With reference to supply chain implementation by manufacturers, it was concluded that European manufacturer 2 implemented the best practices compared to the other manufacturers. Asian manufacturer 1 was the lowest ranked in terms of having implemented supply chain best practices from a moderate to great extent across the supply chain. Across the supply chain, all the manufacturers performed better with implementing best practices on the supply side compared to the distribution side.

- *To determine supply chain challenges faced by local manufacturers of light vehicles in South Africa*

The findings of the study revealed that the challenges facing the South African automotive industry include technological challenges, infrastructural challenges, costs challenges, market/service challenge and production/skills challenges, as discussed in section 8.3. These challenges are also difficult to overcome. Most of the problems such as road freight volumes, delays at ports, unreliability of rail, high fuel costs, high operating costs, high cost sat ports and high prices of materials, are extremely difficult to resolve and are in fact beyond the control of the manufacturers. A few of the challenges are actually avenues on the manufacturers to could focus their efforts to become more competitive such as replacing obsolete assembly/manufacturing tools, finding new markets, cancelling customer orders and improving service levels.

- *To determine the key supply chain performance indicators most important in contributing to optimisation of the supply chain performance of local manufacturers of light vehicles in South Africa*

The main supply chain performance indicator contributing to optimisation of performance is quality, followed by final product delivery reliability and then cost and supplier reliability. Innovation and product variety were rated the lowest. This result also shows that quality is not an issue in the automotive industry and is an important requirement for vehicle manufacturers. Automotive manufacturers are paying more attention to quality issues and thus reducing the number of defects in vehicles. Furthermore, there is no significant difference in quality between vehicles from Japan, America and Europe. The result further shows that all the indicators are essential for optimisation of supply chain performance for the European manufacturers compared to the Asian and American manufacturers, which indicates that the European manufacturers have a number of important characteristics of a responsive supply chain (agile).

- *To determine supply chain strategies of locally manufactured light vehicles based on the product line characteristics*

The study shows that the production line exhibits both characteristics of functional and innovative products. Hence they employ lean and agile supply chain strategies. However, a mismatch between product characteristics and supply chain strategies was found in certain manufacturers. Some models (product lines) such as European manufacturers 1 and 3 indicated that their vehicle was an innovative product, but demand was stable. A mismatch could indicate that the practices and strategies a manufacturer employed were not in line with the strategy they were supposed to implement, in terms of the characteristics of the product, manufacturing techniques and decision drivers. Mismatch leads to incorrect decisions in the supply chain and this generally gives rise to poor supply chain performance.

- *To determine supply chain strategies of locally manufactured light vehicles based on manufacturing characteristics*

The study revealed that the production lines had both characteristics of MTS and MTO - hence the use of a lean and agile supply chain. European manufacturers 1 and 2 hold inventory (manufacturing postponement), suggesting they apply leagile supply chain strategies. The study found a mismatch between the manufacturing characteristics and supply chain strategies at some manufacturers. For example, European manufacturer 3 had a mismatch to a slight extent (wrongly positioned). The manufacturer keeps inventory to a minimum, while engaging in a high cost/differentiated supply chain.

- *To determine supply chain strategies of locally manufactured light vehicles based on characteristics of the decision drivers of SCM*

The results of the study show that there was a relationship between the drivers and strategies. However, it was found that the decision drivers were not always in line with the chosen supply chain strategies. While some of the manufacturers used drivers according to the strategy, others wrongly applied drivers. To some extent there were thus mismatches in the application of the drivers. For example, Asian manufacturer 1 employed a lean supply chain strategy even though it had excess capacity in the production process. Excess capacity is in line with an agile supply chain strategy. A mismatch was also found at European manufacturer 3. This means that these manufacturers were trying to be both lean and agile, without executing the trade-off practices of lean and agile supply chain as required. In addition, European manufacturers 1, 2 and 3, Asian manufacturers 1 and 2, and the American manufacturer utilised quality, cost and flexibility criteria for selecting suppliers which, strictly speaking, is in line with both lean (cost) and agile (flexibility) strategies. This concludes the findings relating to mismatch of practices with strategies of light vehicle manufacturers in South Africa.

- *To determine if there are differences regarding supply chain best practices and strategies between manufacturers of different origin (parent companies)*

Four hypotheses were formulated and tested to answer this research objective. The findings show that the alternative hypotheses were proven to be correct. This means that significant differences were found in practices and strategies between manufacturers of different origin (parent companies). Overall, it was found that European light vehicle manufacturers in South Africa implemented supply chain best practices to a greater extent than the Asian manufacturers as follows: Local manufacturers of European origin implemented long-term relationships with their strategic suppliers to a greater extent; cooperated better with their strategic suppliers to improve processes; had trusting relationships with their strategic suppliers; shared supply chain risks with their strategic suppliers to a greater extent; and shared relevant information with other departments to a greater extent than the Asian manufacturers.

The manufacturers also differed in the way they perceive supply chain challenges as follows:

- The Asian manufacturers showed satisfaction (not a challenge) with their information systems to a greater extent than the European manufacturers.
- The European manufacturers indicated to a greater extent that they were particularly challenged by rail transport and labour problems compared with their Asian counterparts.

There was a significant difference regarding the way they perceived supply chain challenges and the application of performance indicators for optimising their supply chains, as set out below.

- Final product delivery reliability and order delivery lead time were more important in contributing to optimising supply chain performance in the European manufacturers compared with the Asian manufacturers.

Furthermore, there was a significant difference between the European origin and Asian manufacturers regarding their supply chain strategies in terms of product characteristics, manufacturing characteristics and the decision drivers, as set out below.

- The Asian manufacturers agreed to a greater extent that the order lead time takes more than three months and they manufacture according to the projected forecast compared with the European manufacturers.
- The European manufacturers indicated to a greater extent that they make provision in their manufacturing strategy for customers' demand, they quickly change their strategy according to customer demands, they have a pull system with specific customers' orders, their local strategic suppliers are located close to their production plants and they use information on actual demand to be transmitted quickly to reflect real demand accurately compared to the Asian manufacturers.

- *To develop a conceptual framework for determining supply chain best practices in line with a chosen strategy that could guide supply chain managers (locally manufactured light vehicles) in the automotive industry in South Africa in their decision making*

Based on the findings of the study, which identified the shortcomings in the practices and strategies of local manufacturers of light vehicles, a framework for determining supply chain best practices in line with a chosen strategy was developed.

The main research objective of the study was *"to determine whether local manufacturers of light vehicles (OEMs) in South Africa employ supply chain best practices and strategies"*

The findings of the study show that across the supply chain, supply chain best practices were implemented to at least a great extent in all the manufacturers. Automotive manufacturers in South Africa, however, face supply chain challenges which include technological, infrastructural, cost, market/service and production/skills challenges. The most important supply chain performance indicator in contributing to optimisation of performance is quality followed by final product delivery reliability, and then cost and supplier reliability.

Supply chain strategies are implemented to at least a moderate extent. The different production lines (models) exhibit the characteristics of both functional and innovative (customised) products, make-to-stock and make-to-order inventory strategies - hence employing both lean and agile supply chain. Also, the application of the decision drivers in some production lines is not in line with the chosen supply chain strategies (lean or agile). The conclusion can thus be drawn that local manufacturers of light vehicles do not always make decisions and implement practices in line with the chosen supply chain strategies.

8.4.3 Recommendations

Various shortcomings were identified in this study regarding SCM practices and strategies. A framework on how best practices found in the literature were developed, serves as the recommendation for the study. This framework could be used as a tool for determining supply chain best practices and aligning practices with chosen supply chain strategies. These practices and strategies are briefly discussed below.

8.4.3.1 Supply chain best practices

With reference to best practices, it is necessary to further improve the practices in the supply chain for optimal performance. Therefore effective planning, built on shared information and trust between partners, is particularly vital for the functioning of the supply chain. In order for the automotive industry to improve its competitive position, partnerships, long-term relationships, cooperation, collaboration, information sharing, trust, shared technology and a fundamental shift away from managing individual functional processes to managing integrated chains of processes are critical. The benefits of these practices include the following (see chapter 3, section 3.4.4):

- ***Forming strategic partnerships.*** This will improve working relationships, spread risk, increase market power, pre-empt resources, access new markets and improve organisational learning.
- ***Establishing long-term relationships.*** A long-term relationship is critical factor in sustaining competitive advantage. It ensures stable relationships with comparatively few suppliers that can deliver high-quality supplies, sustain delivery schedules and remain flexible relative to changes in specifications and delivery schedules.
- ***Cooperating to improve processes and operations.*** This ensures full integration between the main industry and the by-products industry for the purpose of increasing

competitive power and sustainability of the automotive industry. This process is required for reliability-based cooperation between the main industry and by-products industry. It also leads to development of competitive products and technologies.

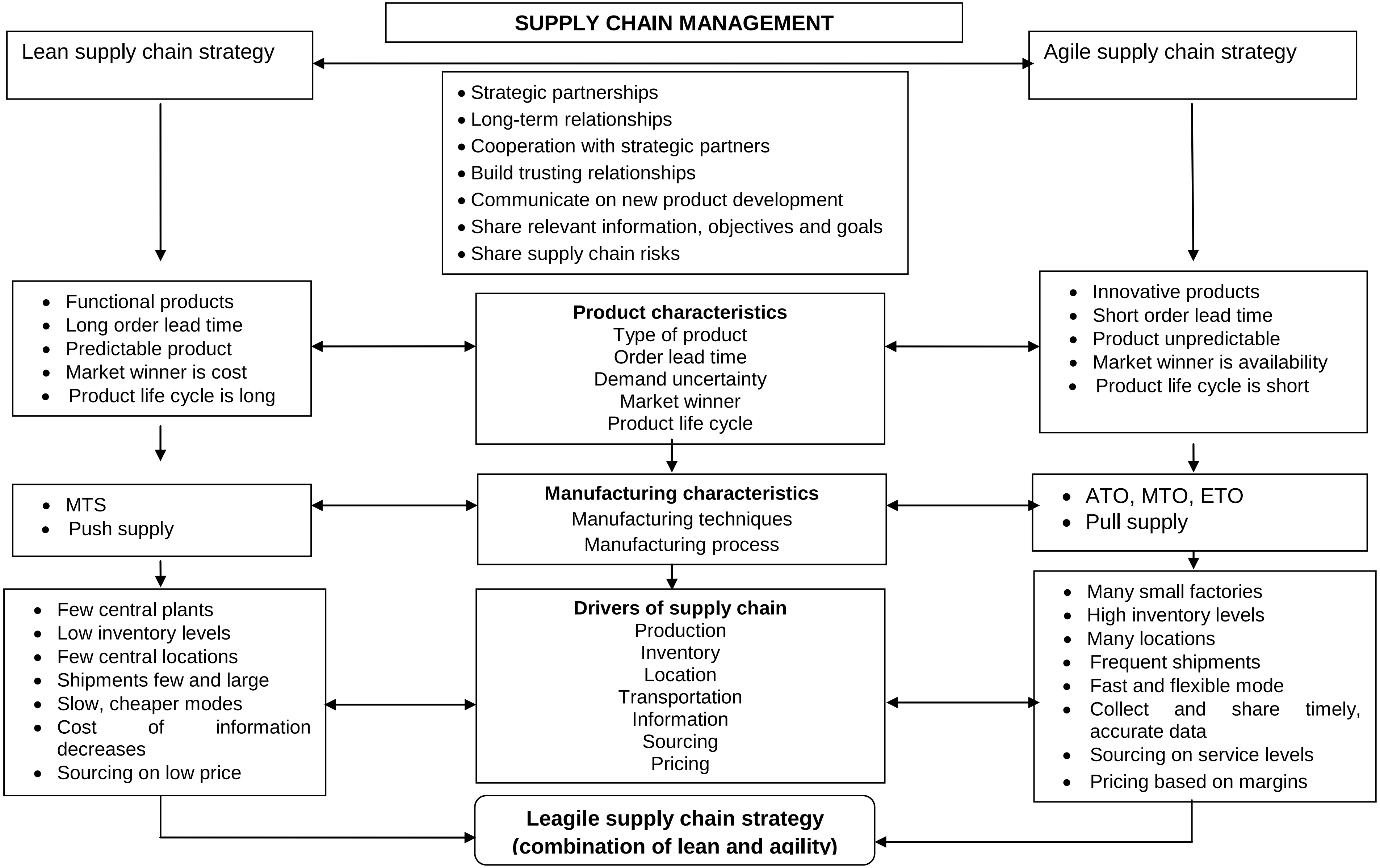
- ***Collaborating on new product development.*** Collaboration will provide the benefits of being able to use the expertise of suppliers to make better designed parts that are easier to manufacture. Making parts that are easier to build can significantly reduce costs and lead times.
- ***Building supply chain trust.*** Trust in the supply chain relationships will provide good levels of performance, efficiency and quality, and obviously requires a serious commitment from the automobile manufacturer. Therefore, a high degree of trust is required. If trust does not exist in the relationship, it would be virtually impossible to expect the level of performance required from suppliers.
- ***Sharing relevant information.*** Information plays a vital role in maintaining sound relationships between supply chain partners. Sharing relevant information amongt business partners will depend on the level of trust in the supply chain relationship.
- ***Sharing supply chain risk.*** Sharing supply chain risk will help to spread risk, increase market power, pre-empt resources, access new markets and improve organisational learning. Strong institutions of collaboration and information sharing should be encouraged.

8.4.3.2 Supply chain strategies

This study found that to some extent there are mismatches between the chosen supply chain strategies and practices employed. Mismatches are the root cause of the problems plaguing many supply chains and therefore supply chain strategies that are based on a one-size-fits-all strategy will fail. An effective supply chain strategy must be aligned with a company's business strategy since a mismatch generally leads to significant problems in business operations. It is therefore imperative for South African supply chain managers to understand their customers' needs and to choose and implement the right strategy for the supply chain to satisfy customer demands. By implementing the optimal supply chain strategy, the South African automotive industry's competitive position would be increased.

It was established in this study that the product characteristics, manufacturing characteristics and decision drivers of SCM are crucial when choosing an optimal supply chain strategy. An organisation can employ a lean (efficient), an agile (responsive) or a combination of lean and agile supply chain (leagile) strategies. Figure 8.4 illustrates the conceptual framework for aligning supply chain practices and strategies, and thus an optimal strategy.

Figure 8.4: Conceptual framework for supply chain practices and strategies



8.5 LIMITATIONS OF THE STUDY AND AVENUES FOR FUTURE RESEARCH

The quality of this research was discussed in chapter 6. However, there are certain limitations worth mentioning. The study focused on local manufacturers of light vehicles in the South African automotive industry. The total target population was included, but unfortunately one of the light vehicle manufacturer was unwilling to participate in the study. It is not known if the findings of the study would have been different with the involvement of that company.

A conceptual framework for guiding supply chain practices according to chosen strategies was developed. However, the framework was not tested to determine its applicability in practice. Further research is suggested on the following:

- testing of the conceptual framework
- investigating risk sharing in supply chains
- investigating cooperative relationships with regard to the outbound supply chain

8.6 SUMMARY OF THE RESEARCH FINDINGS

This study determined whether local manufacturers of light vehicles in South Africa employ optimal supply chain best practices and strategies. To achieve this goal, an exploratory and descriptive research design was employed using both qualitative and quantitative techniques. All light vehicle manufacturers in South Africa were involved (total population) except for one, and the respondents were selected by means of a purposive sampling technique. The findings of the study revealed that light vehicle manufacturers in South Africa employ supply chain best practices to at least a great extent. All the manufacturers followed a lean strategy for their inbound supply chain and a number of the manufacturers had a lean supply chain strategy for their outbound supply chain. A number of the manufacturers also had an agile supply chain strategy in the outbound supply chain which suggests a leagile supply chain strategy. It was also found that in some instances, there was a mismatch between strategies and practices in the area of product characteristics, manufacturing characteristics and the decision drivers of the supply chain.

A mismatch could be the root cause of problems plaguing the efficiency and effectiveness of many supply chains. It is therefore essential for supply chain managers to have clarity on their chosen strategy to employ practices in line with strategy. Implementing the right supply chain strategy could improve SCM performance.

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APPENDIX I: INTERVIEW QUESTIONNAIRE

INTERVIEW QUESTIONNAIRE

DETERMINING SUPPLY CHAIN PRACTICES AND STRATEGIES OF LIGHT VEHICLE MANUFACTURERS IN SOUTH AFRICA

Dear Respondent

The main objective of the study is to determine whether local manufacturers (OEMs) of light vehicles in South Africa employ supply chain best practices and strategies in the current circumstances.

The study explores the supply chain practices of OEMs in the South African automotive industry in an attempt to better understand the industry and investigate and finding optimal supply chain strategies, thereby improving the performance of automotive companies in South Africa.

The interview questionnaire comprises two sections:
Section A: Current supply chain management best practices
Section B: Determining the supply chain strategies

Please tick (x) the option on how your company is addressing supply chain management issues.

Note:

(i) The questionnaire needs to be completed for a particular vehicle (model) **ONLY.**

(ii) A five-point Likert scale is used. The end points of the questions are (1) "strongly disagree" to (5) "strongly agree" and (1) "no extent" to (5) "to a very great extent".

(iii) The interviewer will gladly clarify and explain any questions about which the interviewee may be unsure.

SECTION A: SUPPLY CHAIN MANAGEMENT BEST PRACTICES (VEHICLE/MODEL)

This questionnaire is completed for -- vehicle (model).

Questions 1 to 6 relate to current supply chain management in your organisation. This section of the questionnaire is subdivided into INBOUND SUPPLY CHAIN (relationship with suppliers); INTERNAL SUPPLY CHAIN (the company); and OUTBOUND SUPPLY CHAIN (relationship with customers).

A1 INBOUND SUPPLY CHAIN

1 Please indicate to what extent you implement the following practices:

Where 1 = no extent, 2 = slight extent, 3 = moderate extent, 4 = great extent, and 5 = very great extent					
We form strategic partnerships with our suppliers	1	2	3	4	5
We have long-term relationships with our strategic suppliers	1	2	3	4	5
We cooperate with our strategic suppliers to improve operations	1	2	3	4	5
We cooperate with our strategic suppliers to improve processes	1	2	3	4	5
We have trusting relationships with our strategic suppliers	1	2	3	4	5
We communicate with our strategic suppliers on new product development	1	2	3	4	5
We share relevant information with our strategic suppliers	1	2	3	4	5
We share our objectives and goals with our strategic suppliers	1	2	3	4	5
We share supply chain risks with our strategic suppliers	1	2	3	4	5

A2: OUTBOUND SUPPLY CHAIN

2 Please indicate to what extent you implement the following practices:

Where 1 = no extent, 2 = slight extent, 3 = moderate extent, 4 = large extent, and 5 = very large extent					
We form strategic partnerships with our customers	1	2	3	4	5
We have a long-term relationships with our strategic customers	1	2	3	4	5
We cooperate with our strategic customers to improve operations	1	2	3	4	5
We cooperate with our strategic customers to improve processes	1	2	3	4	5
We have trusting relationships with our strategic customers	1	2	3	4	5
We communicate with our strategic customers on new product development	1	2	3	4	5
We share relevant information with our strategic customers	1	2	3	4	5
We share our objectives and goals with our strategic customers	1	2	3	4	5
We share supply chain risks with our strategic customers	1	2	3	4	5

A3: INTERNAL SUPPLY CHAIN (with other departments in our company)

3 Please indicate to what extent you implement the following practices:

Where 1 = no extent, 2 = slight extent, 3 = moderate extent, 4 = large extent, and 5 = very large extent.					
We cooperate with other departments to improve operations	1	2	3	4	5
We cooperate with other departments to improve processes	1	2	3	4	5
We communicate with other departments on new product development	1	2	3	4	5
We share relevant information with other departments	1	2	3	4	5
We ensure alignment between our objectives and goals and those of other departments	1	2	3	4	5
We share supply chain risks with other departments	1	2	3	4	5

4 The following statements may be potential challenges in your supply chain. Please indicate (1) your level of agreement: and (2) if you agree or strongly agree, please indicate the relative complexity of overcoming such challenges:

1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree

And for complexity of overcoming:

1. Very easy to overcome; few resources needed, little time or complexity
2. Somewhat easy to fix, some resources and time needed, but not taxing for the enterprise
3. Moderately difficult, can be remediated with moderate resources and time, moderate complexity
4. Somewhat difficult to overcome, requires resources, time and is most likely complex
5. Extremely difficult to overcome, high impact on resources and time, very complex

Statements	**Level of agreement**					**Complexity to overcome**				
We have inadequate information systems	1	2	3	4	5	1	2	3	4	5
We do not have an efficient planning and forecasting tool	1	2	3	4	5	1	2	3	4	5
We incur high cost when replacing obsolete assembly/manufacturing tools	1	2	3	4	5	1	2	3	4	5
We do not have sustainable infrastructure	1	2	3	4	5	1	2	3	4	5
The rail transport is unreliable	1	2	3	4	5	1	2	3	4	5
We normally have rail capacity problems	1	2	3	4	5	1	2	3	4	5
Increased road freight volumes	1	2	3	4	5	1	2	3	4	5
We are challenged by delays at ports	1	2	3	4	5	1	2	3	4	5
High fuel costs affect our operating cost	1	2	3	4	5	1	2	3	4	5
We have high operating costs	1	2	3	4	5	1	2	3	4	5
We incur high cost at South African ports	1	2	3	4	5	1	2	3	4	5
The prices of materials/components are high	1	2	3	4	5	1	2	3	4	5
It is difficult finding a new supply market	1	2	3	4	5	1	2	3	4	5
Sometimes our customers cancel their orders	1	2	3	4	5	1	2	3	4	5
We are challenged to improve our service level	1	2	3	4	5	1	2	3	4	5
It is difficult to verify the BEE status (scorecards) of our strategic suppliers	1	2	3	4	5	1	2	3	4	5
It is sometimes difficult to collaborate with our strategic suppliers	1	2	3	4	5	1	2	3	4	5
It is sometimes difficult to collaborate with our strategic customers	1	2	3	4	5	1	2	3	4	5
We operate with a low level of collaboration	1	2	3	4	5	1	2	3	4	5
We have unreliable production schedules	1	2	3	4	5	1	2	3	4	5
We are challenged by a lack of capacity	1	2	3	4	5	1	2	3	4	5
We are challenged by a lack of skills	1	2	3	4	5	1	2	3	4	5
We are challenged by labour problems	1	2	3	4	5	1	2	3	4	5
Please state other critical impact challenges:										

5 Please indicate how important you would rate each of the following ten key supply chain performance indicators out of 100 (eg cost = 85), in contributing to optimising supply chain performance. Please enter the rating in the column provided.

Supply chain indicators	**Rank**
Cost (cost associated with producing the vehicle)	
Quality (meeting quality standards of the vehicle)	
Flexibility (ability to respond to changing needs of customers)	
Supplier reliability (we rely on the effectiveness of our suppliers)	
Innovation (radical and incremental changes in the vehicle production process)	
Responsiveness (how quickly vehicles are delivered to customers)	
Order delivery lead time (time taken to complete all activities from order to delivery)	
Final product delivery reliability (delivery of the right vehicle at the right time to customers)	
Product variety (variety of models of the vehicle offered on the market)	
Supply chain asset management (effectiveness of managing assets to support demand satisfaction)	
State the key reason(s) for your rating:	

SECTION B

QUESTIONS 6 TO 12 RELATE TO SUPPLY CHAIN STRATEGIES IN YOUR COMPANY.

THIS SECTION OF THE QUESTIONNAIRE DETERMINES THE RELATIONSHIP BETWEEN PRODUCT CHARACTERISTICS, MANUFACTURING CHARACTERISTICS, THE DECISION DRIVERS OF THE SUPPLY CHAIN AND THE SUPPLY CHAIN STRATEGY.

B1: THE RELATIONSHIP BETWEEN PRODUCT CHARACTERISTICS AND SUPPLY CHAIN STRATEGIES

6 Indicate your level of agreement with the following statements on the characteristics of the product line (model):

Where 1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, and 5 = strongly agree					
The model is a standard vehicle (no customisation)	1	2	3	4	5
The demand for the model (vehicle) is stable	1	2	3	4	5
The market winner (most important sales criteria/point) for the model is cost	1	2	3	4	5
The order lead time (order to delivery) takes more than three months	1	2	3	4	5
Our forecast for the model is relatively accurate	1	2	3	4	5

B2: THE RELATIONSHIP BETWEEN THE MANUFACTURING CHARACTERISTICS AND SUPPLY CHAIN STRATEGIES

7 Please indicate your level of agreement regarding the following manufacturing characteristics of the product line (make-to-stock [MTS], make-to-order [MTO]).

Where 1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, and 5 = strongly agree					
We have a low manufacturing cost strategy	1	2	3	4	5
We make provision in our manufacturing strategy for customers' demands (specifications)	1	2	3	4	5
We change our manufacturing strategy quickly according to customer demands	1	2	3	4	5
We customise some parts in our production process to meet certain	1	2	3	4	5

customer orders					
We keep minimum inventory in the production process	1	2	3	4	5
We manufacture on the basis of projected forecast	1	2	3	4	5
We have a pull system with specific customer orders	1	2	3	4	5

8 Which of the following manufacturing strategies best suit the production line for this model?

Make-to-stock (MTS)		Make-to-order (MTO)	
Others: Please state: ---			

9 Which of the following statements relating to postponement are applicable to this model?

Where 1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, and 5 = strongly agree					
Our strategic suppliers keep inventory in the form of modules, components and materials	1	2	3	4	5
We keep fully assembled vehicles in stock (assembled vehicles)	1	2	3	4	5
Our dealers keep fully assembled vehicles in stock	1	2	3	4	5
We keep work-in-progress inventory to be customised for specific customer orders	1	2	3	4	5
We only order modules, components and materials from our strategic suppliers when the customer specifications are known	1	2	3	4	5
We make provision for finalisation of some features to our vehicles at the dealership, based on final customer request	1	2	3	4	5

B3: THE RELATIONSHIP BETWEEN DECISION DRIVERS AND SUPPLY CHAIN STRATEGY

10 Please indicate the extent to which the following decision drivers of supply chain are applied in the production line:

Where 1 = no extent, 2 = slight extent, 3 = moderate extent, 4 = great extent and 5 = very great extent						
Production	We have excess capacity in our production process	1	2	3	4	5
	We have flexible manufacturing processes	1	2	3	4	5
Inventory	We work on strict JIT system and therefore keep inventory holding in the production process to a minimum	1	2	3	4	5
Location	We have decentralised distribution centres (stores) to serve our dealers	1	2	3	4	5
	Our local strategic suppliers are located close to our production plant	1	2	3	4	5
Transportation	We make small and frequent shipments to our strategic customers	1	2	3	4	5
	We receive small and frequent shipments from our strategic suppliers	1	2	3	4	5
	We make use of the lowest acceptable mode of transportation for parts purchase from our strategic suppliers	1	2	3	4	5
	We make use of the lowest acceptable mode of transportation for vehicles to our dealers	1	2	3	4	5
Information	Information helps us to build master production schedule (forecasts) and create delivery dates	1	2	3	4	5
	Information is used on actual demand to be transmitted quickly to reflect real demand accurately	1	2	3	4	5
Supplier selection	We select suppliers based on low price/cost	1	2	3	4	5
	We select suppliers on the bias of high-quality standards	1	2	3	4	5
	We select suppliers on the basis of dependability/sustainability	1	2	3	4	5
	We select suppliers on the basis of flexibility	1	2	3	4	5
Pricing strategy	Our pricing strategy is determined by balancing supply and demand	1	2	3	4	5
	Our pricing strategy is based on low margins (low margins based on high volume)	1	2	3	4	5
	Our pricing strategy is based on differentiation in the market	1	2	3	4	5

11 Which of the following supply chain strategy for the product line is used for the inbound supply chain? Please mark all the ones that apply.

	Lean supply chain strategy (efficiency)
	Agile supply chain strategy (responsiveness)

12 Which of the following supply chain strategies for the product line are used for the outbound supply chain? Please mark all the ones that apply.

	Lean supply chain strategy (efficiency)
	Agile supply chain strategy (responsiveness)

THANK YOU FOR PARTICIPATING (GOD BLESS)

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APPENDIX II: MANN-WHITNEY TESTS

Supply chain best practices

Test statistics[b]

	A1.1	A1.2	A1.3	A1.4	A1.5	A1.6
Mann-Whitney U	7.000	5.000	5.000	2.500	3.000	10.500
Wilcoxon W	22.000	20.000	20.000	17.500	18.000	25.500
Z	-1.315	-1.964	-1.936	-2.390	-2.154	-.454
Asymp sig (2-tailed)	.189	.050	.053	.017	.031	.650
Exact sig [2*(1-tailed sig)]	.310[a]	.151[a]	.151[a]	.032[a]	.056[a]	.690[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	A1.7	A1.8	A1.9	A2.1	A2.2	A2.3
Mann-Whitney U	10.000	8.000	4.000	8.000	11.000	5.500
Wilcoxon W	25.000	23.000	19.000	23.000	26.000	20.500
Z	-.600	-1.342	-1.844	-.986	-.346	-1.534
Asymp sig (2-tailed)	.549	.180	.065	.324	.729	.125
Exact sig [2*(1-tailed sig)]	.690[a]	.421[a]	.095[a]	.421[a]	.841[a]	.151[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	A2.4	A2.5	A2.6	A2.7	A2.8	A2.9
Mann-Whitney U	7.000	7.000	11.000	7.000	5.500	3.500
Wilcoxon W	22.000	22.000	26.000	22.000	20.500	18.500
Z	-1.193	-1.247	-.339	-1.247	-1.534	-1.972
Asymp sig (2-tailed)	.233	.212	.735	.212	.125	.049
Exact sig [2*(1-tailed sig)]	.310[a]	.310[a]	.841[a]	.310[a]	.151[a]	.056[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	A3.1	A3.2	A3.3	A3.4	A3.5	A3.6
Mann-Whitney U	10.500	9.000	11.000	5.000	9.500	11.000
Wilcoxon W	25.500	24.000	26.000	20.000	24.500	26.000
Z	-.454	-.808	-.339	-1.964	-.680	-.329
Asymp sig (2-tailed)	.650	.419	.735	.050	.496	.742
Exact sig. [2*(1-tailed sig)]	.690[a]	.548[a]	.841[a]	.151[a]	.548[a]	.841[a]

a. Not corrected for ties.

Test statistics[b]

	A3.1	A3.2	A3.3	A3.4	A3.5	A3.6
Mann-Whitney U	10.500	9.000	11.000	5.000	9.500	11.000
Wilcoxon W	25.500	24.000	26.000	20.000	24.500	26.000
Z	-.454	-.808	-.339	-1.964	-.680	-.329
Asymp sig (2-tailed)	.650	.419	.735	.050	.496	.742
Exact sig. [2*(1-tailed sig)]	.690[a]	.548[a]	.841[a]	.151[a]	.548[a]	.841[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Supply chain challenges

Test statistics[b]

	A4.1a	A4.2a	A4.3a	A4.4a	A4.5a	A4.6a
Mann-Whitney U	2.500	6.500	10.000	5.000	1.000	4.500
Wilcoxon W	17.500	21.500	25.000	20.000	16.000	19.500
Z	-2.362	-1.361	-1.000	-1.671	-2.495	-1.848
Asymp sig (2-tailed)	.018	.174	.317	.095	.013	.065
Exact sig [2*(1-tailed sig)]	.032[a]	.222[a]	.690[a]	.151[a]	.016[a]	.095[a]

a. Not corrected for ties.

b. Grouping variable: PARENTAREA

Test statistics[b]

	A4.7a	A4.8a	A4.9a	A4.10a	A4.11a	A4.12a
Mann-Whitney U	9.500	7.000	7.500	10.500	7.000	5.500
Wilcoxon W	24.500	22.000	22.500	25.500	17.000	15.500
Z	-.657	-1.315	-1.225	-.454	-.894	-1.214
Asymp. Sig. (2-tailed)	.511	.189	.221	.650	.371	.225
Exact Sig. [2*(1-tailed Sig.)]	.548[a]	.310[a]	.310[a]	.690[a]	.556[a]	.286[a]

Supply chain performance indicators

Test statistics[b]

	A5.1	A5.2	A5.3	A5.4	A5.5	A5.6
Mann-Whitney U	9.000	1.000	6.000	12.000	2.000	8.000
Wilcoxon W	24.000	16.000	21.000	27.000	17.000	23.000
Z	-.745	-2.471	-1.392	-.108	-2.207	-.964
Asymp sig (2-tailed)	.456	.013	.164	.914	.027	.335
Exact sig [2*(1-tailed sig)]	.548[a]	.016[a]	.222[a]	1.000[a]	.032[a]	.421[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	A5.7	A5.8	A5.9	A5.10
Mann-Whitney U	11.000	11.000	5.000	6.500
Wilcoxon W	26.000	26.000	20.000	21.500
Z	-.320	-.325	-1.622	-1.273
Asymp sig (2-tailed)	.749	.745	.105	.203
Exact sig [2*(1-tailed sig)]	.841[a]	.841[a]	.151[a]	.222[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Supply chain strategies

Test statistics[b]

	B6.1	B6.2	B6.3	B6.4	B6.5	B7.1
Mann-Whitney U	4.000	7.500	7.000	4.000	7.500	5.500
Wilcoxon W	19.000	22.500	22.000	19.000	22.500	20.500
Z	-1.844	-1.491	-1.193	-2.008	-1.491	-1.529
Asymp sig (2-tailed)	.065	.136	.233	.045	.136	.126
Exact sig [2*(1-tailed sig)]	.095[a]	.310[a]	.310[a]	.095[a]	.310[a]	.151[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	B7.2	B7.3	B7.4	B7.5	B7.6	B7.7
Mann-Whitney U	3.000	3.000	4.000	6.500	5.000	2.000
Wilcoxon W	18.000	18.000	19.000	21.500	20.000	17.000
Z	-2.147	-2.081	-1.844	-1.361	-1.964	-2.300
Asymp sig (2-tailed)	.032	.037	.065	.174	.050	.021
Exact sig. [2*(1-tailed sig)]	.056[a]	.056[a]	.095[a]	.222[a]	.151[a]	.032[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	B9.1	B9.2	B9.3	B9.4	B9.5	B9.6
Mann-Whitney U	10.000	12.000	10.000	8.500	4.500	7.000
Wilcoxon W	25.000	27.000	25.000	23.500	19.500	22.000
Z	-1.000	-.149	-.655	-.876	-1.890	-1.243
Asymp sig (2-tailed)	.317	.881	.513	.381	.059	.214
Exact sig [2*(1-tailed sig)]	.690[a]	1.000[a]	.690[a]	.421[a]	.095[a]	.310[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	B10.1	B10.2	B10.3	B10.4	B10.5	B10.6
Mann-Whitney U	12.000	9.000	7.500	9.500	3.000	8.500
Wilcoxon W	27.000	24.000	22.500	24.500	18.000	23.500
Z	-.108	-.254	-1.107	-.680	-2.132	-.956
Asymp sig (2-tailed)	.914	.800	.268	.496	.033	.339
Exact sig [2*(1-tailed sig)]	1.000[a]	.905[a]	.310[a]	.548[a]	.056[a]	.421[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	B10.7	B10.8	B10.9	B10.10	B10.11	B10.12
Mann-Whitney U	12.000	11.500	9.000	7.500	3.500	8.500
Wilcoxon W	27.000	26.500	24.000	22.500	18.500	23.500
Z	-.110	-.219	-.827	-1.225	-2.019	-.894
Asymp sig (2-tailed)	.913	.827	.408	.221	.043	.371
Exact sig [2*(1-tailed sig)]	1.000[a]	.841[a]	.548[a]	.310[a]	.056[a]	.421[a]

a. Not corrected for ties.

b. Grouping variable: parentarea

Test statistics[b]

	B10.13	B10.14	B10.15	B10.16	B10.17	B10.18
Mann-Whitney U	7.000	7.500	5.000	5.000	6.000	6.500
Wilcoxon W	22.000	22.500	20.000	20.000	21.000	21.500
Z	-1.315	-1.107	-1.643	-1.643	-1.453	-1.423
Asymp sig (2-tailed)	.189	.268	.100	.100	.146	.155
Exact sig [2*(1-tailed sig)]	.310[a]	.310[a]	.151[a]	.151[a]	.222[a]	.222[a]

a. Not corrected for ties.